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Instructional-cum-Practical Manual
for Vocational Pupils

# FRUIT CULTURE

## Contributors

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## CONTENTS

Page No.

Preface i

Introduction 1

Importance of fruit culture 6

Activity Units

1. Visiting an orchards for identification of fruit crops and their varieties 10
2. Planting of fruit plants (mango, banana, papaya and lime) 20
3. Laying out different systems of irrigation for young and adult trees 29
4. Training of mango, citrus, guava, sapota, pomegranate and fig. 39
5. Training of grape on bower and head systems 49
6. Pruning of grape varieties 57
7. Pruning of pomegranate, phalsa and ber 68
8. Notching and pruning in fig 73
9. Study of flowering habit in fruit crops and their flower sex ratio. 81
10. Study of pollination in custard apple and performing hand pollination 88
11. Study of fruit set and fruit drop in mango, citrus grapes, guava and sapota 100
12. Intercultural operations in fruit crops 109
13. Manuring of different fruit crops 117
14. Foliar application of nutrients in fruit trees 125
15. Selection and care of fruit crops 135
16. Study of morphological characters of fruit crops 141
17. Evaluation of taste of cultivars of fruit crops 153
18. Calculation of cost of cultivation in different fruit crops 160
19. Study of marketing of fruits 166
20. Study of a declining orchard 177

Appendix. I. List of important nurseries in India 185

II. List of contributors 190

Questionnaires for collecting opinions of:

- the teachers on the Manual
- the pupils on the Manual

## PREFACE

Ever since the introduction of vocationalization in our school system by several States in our country the paucity of appropriate instructional materials has been felt as one of the major constraints in implementation of the programme and a source of great hardship to pupils offering vocational studies at the higher secondary stage.

The Department of Vocationalization of Education of the National Council of Educational Research and Training, New Delhi has started a modest programme of developing instructional materials of diverse types to fill up this void in all major areas of vocational education. The task is too gigantic to be completed by any single agency but the model material being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidelines developed by a working group of experts constituted by NCERT.

The present manual is on "Fruit Culture" and is common portion of the Horticulture or related courses in a number of States. It contains activities (Practical exercises) to be performed by pupils with simple steps to follow, precautions to be taken and data to be obtained and processed. Each activity is complete with brief theoretical information, objectives, behavioural outcome, evaluation etc. It is hoped that the pupils will find them immensely useful.

The pages that follow contain a draft of the writing which will be finalised after obtaining the responses and feed-back from pupils, teachers and others concerned. The material will then be published in the printed form.

The users are requested to complete the questionnaire appended and return it to us. Comments and suggestions for improvement of the materials are also welcome.

The material has been developed by a group of experts as authors in a workshop held at the University of Agricultural Sciences, Bangalore. The names are mentioned elsewhere and their contributions are admirably acknowledged. Our thanks are also due to Dr. U.V. Sulladnath, Professor and Head, Division of Horticulture, UAS, College of Agriculture, Dharwad, for the pains he took in varyfying the authenticity of contents of the manual. Dr. A.K. Sacheti, Reader and Dr. A.K. Dhote, Lecturer, Department of Vocationalization of Education deserve special thanks for editing and bringing the materials in the present form. The assistance of all in the University of Agricultural Sciences, Bangalore, and Department of Vocationalization of Education, NCERT is also thankfully acknowledged.

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# INTRODUCTION

About 17 different groups of vocational courses in agriculture area have been introduced by the six States and three Union Territories, so far. These courses are in vogue for the last 4 - 5 years. From the very beginning, the Department of Vocationalization of Education ( the erst-while VE Unit) of NCERT is working hand in hand with the State functionaries through various programmes organised for the State officials, vocational teachers and others. In fact, by now the Department has conducted on-the-spot studies of vocational programmes for all the states except Tamil Nadu to find out the merits and demerits of the programme and to suggest appropriate measures to solve the issues pertaining to the scheme. Beside these studies, the Department has also organised short-term teacher training programmes in agriculture. All these programmes have revealed that there is a great dearth of suitable textual instructional materials, specially the need of practical manuals was urgently felt. Supply of instructional materials and imparting of practical training becomes still more essential when one looks at the purpose with which the vocationalization of education scheme has been launched. The main aim is to prepare the pupil for purposeful and gainful employment (wage or self-employment).

To develop models of instructional materials, the Department constituted a Working Group to formulate guidelines for the development of different types of instructional materials and to prepare brief examplar units.

Based on the guidelines supplied by the Working Group, Horticulture which is an important and popular vocational course in agriculture was selected for the purpose of development of instructional-cum-practical manuals. Later, the work of teacher's guide development and text books writing shall also be taken up.

The content of the Horticulture and similar courses offered by the States and Union Territories under different titles was thoroughly analysed and it was felt appropriate to develop six such manuals to cater to the needs of the course. The present manual is one of them. While developing the manual, care was taken that it should include maximum number of activity Units(practical exercises) so that it fulfils the requirement of the course prescribed by the States and Union Territories in the Horticulture group of courses and also other vocational courses.

This manual is envisaged to help both teachers and pupils in the pursuit of " Fruit Culture " which is a part of the vocation Horticulture. It explains 'what' 'why', and 'how' of the activity Units which are essential to develop required vocational skills in the students.

In the manual each activity Unit has been dealt in several sub-heads, viz. instructional objectives, relevant information, precautions, materials required, procedure, observations, expected behavioural outcome and questions.

Before commencing with actual work for any activity Unit, the teacher should know what exactly pupils have to learn and do and whether they will be able to do that? Therefore, in the beginning instructional objectives in behavioural terms should be framed by the teacher for the students.

In order to acquaint the pupils about the Activity Unit the teacher should provide them with required theoretical knowledge or information relevant to the activity. This will help the pupil in proper understanding of the Activity Unit. In other words 'what' and 'why' part of the Activity Unit should be explained well in advance by the teachers.

Once the pupils have understood, the relevant theoretical informations, the teacher should tell them about the precautions which are to be followed before and during actual execution of the activity Unit. This will facilitate their smooth working. 'How' part of the manual will be described in the 'procedure' which pupil will follow while performing the Activity Unit.

Under the sub-head 'Observations', the pupil shall observe the situation, take readings, and similar other points as suggested under each Unit which may vary from Unit to Unit. Wherever calculations are required to be done to obtain the results, they are also mentioned under this head.

activity, the pupil shall acquire abilities which should be closely related with instructional objectives given under each activity Unit. Those abilities shall be listed under the sub-head 'expected behavioural outcome'. Evaluation shall be based on the abilities acquired and it will be done by the concerned teachers.

For evaluating each aspect, the teacher will use 4 point scale ie A, B, C & D and for each activity Unit Grade Point Average can be calculated as indicated below:

Suppose there are four aspects or abilities and each carries equal weightage and a student obtains 2A's, I C and 1 D and if A = 4 point, B = 3 point, C = 2 point, D = 1 point, based on the grades the pupil will get 11 points and when this is divided by the total number of aspects examined it will give grade point average, in this case it is 2.75. Tabular presentation is as under:

| Aspect/ Ability | Weighage | Grade obtained | Total points weightage x point equivalent to grade obtained | | | Grade point average |
|---|---|---|---|---|---|---|
| 1 | 1 | A | 1 x 4 | 4 | | |
| 2 | 1 | C | 1 x 2 | 2 | $\frac{11}{4}$ | 2.75 |
| 3 | 1 | D | 1 x 1 | 1 | | |
| 4 | 1 | A | 1 x 4 | 4 | | |
| | | | | 11 | | |

A = 4 point, B = 3 point, C = 2 point, D = 1 point

In the last, some questions related with the Activity Units are also given, the students shall write the appropriate answers after the completion of the Activity Unit and teacher shall examine them. If required, he shall do suitable corrections and give suggestions. However, answoı to these questions will not be considered for the purpose of grading.

## Importance of Fruit Culture

Fruit culture in India has been practiced from the very ancient times. Indians from the very beginning, have been the lovers of fruits and gardens. In the past, many kings and emperors patronised the cultivation of fruits in their territories. The best example is of Mughals, who helped establishment of countless mango orchards all over their empire.. Over centuries, the art and science of fruit culture has been carefully nursed and fortified with new ideas and concepts, and now it is developed into a most civilized, skillful and intensive form of land utilization.

Though the antiquity of fruit culture in India dates back to pre-historic times, its commercial culture started only in the beginning of this century or probably even later. Although upto-date and accurate statistics are not available, the estimated area under fruits in India is about 3.2 million hectares constituting about 2 per cent of the net cultivated area in India (Singh, 1969). Likewise, the production of fruits in the country is estimated at 10 million tonnes annually. At this juncture, one can confidently point out that since the last decade, the area under fruits is under constant and rapid increase, thanks to the efforts of various States and Agricultural Universities, who have taken several effective measures to encourage fruits production on scientific lines.

Fruit culture has been described as one of the fascinating avocations of farming profession, which influences the economy of not only the grower, but also that of the nation. It is generally said that the standard of living of a country can be judged by its production and consumption of fruits per capita. Thus, fruit production is taken as a symbol of prosperity of a nation. In all these years, India was utilizing all the fruits that it produced; but since the recent past, a substantial export business of fruits has emerged because of enhanced production and attainment of high quality standards.

Importance of fruits in the human diet is universally recognised. All fruits, in one way or the other, are the prime sources of vitamins, minerals, sugars, proteins, etc., which are essential for maintaining good health. They form a wholesome item of food. The consumption of fruits stimulates the mental activity and leads to pleasantness of mind. Quite a few fruits are also considered to possess specific medicinal properties. For all these reason the use of fruits in the daily diet is imperative.

Fruits and fruit-culture, apart from what they contribute materially to our lives, nourish us aesthetically, emotionally and spiritually through their varied forms, colours, tastes, flavours and other sensory features and the exquisite looks that the trees provide. The fruits and fruit trees are not only themselves beautiful and eye-catching, but enhance the beauty of the surrounding also. The emotional and aesthetic rewards of fruit culture are really priceless.

The increasing population and the commercialization of fruit culture, have now thrown an open challenge to the fruit industry in India, for production of greater quantities of fruits than ever before. The acceptance of the challenge has been inevitable and many ways and means have been now devised to accomplish greater production on scientific lines. Not only larger and larger areas are planted with fruits and new varieties are tried, but also advice on their culture is sought in the light of the latest research findings. Technical graduates trained in scientific fruit production in the Agricultural Universities and other institutions, are at work in this direction. Research stations all over the country are making efforts to overcome the hurdles that come in the way of fruit culture. The Central and the State Governments are leaving no stone unturned for promotion of horticulture in the country.

The demand of the present situation bestows no less importance on the vocational training to be imparted to the interested growers. The grower should be bestowed with sufficient knowledge of fruit culture for success in this venture. It is equally important that development and extension officials of the State Governments and the Agricultural Universities are fully conversant with the latest technology in fruits culture.

This manual on fruit culture has been specially and purposely designed to suit the practical requirements of all the vocationals in this field. The practicals included in the manual help these vocationals in gathering many ideas that are pre-requisite to successful fruit culture. It is hoped that even a beginner, after undergoing this vocational practical course, will be confident enough to advise and assist fruit growers in all their requirements.

The manual will be of immense use to the nursery men and gardeners, who need a thorough and fool-proof background to their profession. Through these practical lessons, it is intended to impart training in the essential horticultural practices to be followed in an orchard such as plant propagation, planting, pruning, training, fertiliser applications plant protection, harvesting and other allied aspects of important fruit crops. This course to a large extent helps them to understand the techniques and importance of such orchard operations. The knowledge gained will be useful to them in starting their own nursery or fruit orchard, or working for others.

## 1. Activity Unit: VISITING AN ORCHARD FOR IDENTIFICATION OF FRUIT CROPS AND THEIR VARIETIES

### 1.1 Instructional Objectives:

The pupil should be able to:

- know the constituents of an orchard;
- collect the information about different
- fruit crops grown in the orchard;
- collect information about the different varieties of the fruit crops in the orchard;
- know different types of orchards;
- acquaint and record the problems in the management of the orchard.

### 1.2 Relevant information:

What is an orchard?

An orchard is one where different fruit crops have been planted in an orderly manner and are managed for production of successive yields for economic returns.

What are the different types of orchards?

There are broadly six types of orchards:

i) Orchard with a single variety of a particular fruit crop:

This is the most common system of orcharding with certain advantages such as: the purity of the variety of the fruit crop can be maintained; a specific spacing desired of a variety can be conveniently followed; convenient for easy management practices; the diseases and pests that may attack other varieties may be eliminated and harvest and disposal of fruits is easy as the fruits come to harvest at almost one time.

At the same time, there are also certain disadvantages such as: failure in fruit setting due to self incompatibility problem of the variety and loss of total crop if the variety chosen is prone to specific disease and pest attack.

ii. Orchard with different varieties of a particular fruit crop:

In this type of orchard, more than one variety of a fruit crop are planted with certain advantages viz. if the crop of one variety fails in a year for any reason the other variety may yield; while one variety may be susceptible for certain pests and diseases, the others may escape and fruit setting problem may be avoided. The dis-advantages of this type of orchard are: difficulty involved in maintaining the purity of the variety; orchard man-agement becomes difficult due to different spacings; the whole of the orchard may not come to harvest at one time and it may be difficult to meet the cultural needs of different varieties.

iii. Mixed orchard with fruit crops of almost equal life span:

Fruit crops of almost equal life span or requirements in respect of their culture may be planted under this system. Some of the combinations for planting could be sapota and guava; lime, guava and pomegranate; mango and cashew and several others. This system has advantages like, availability of different fruits; if one crop fails, the other may be successful thus ensuring some returns to the grower. At the same time, there are also certain difficulties encountered in the system: problems in the management of the orchard due to their different cultural requirements, and the orchard may become a source for a particular disease or pest to which the crops may be prone to.

iv. Orchards with short duration inter-crops:

In this system, a main fruit crop of generally long duration are planted wide apart. The inter-row spaces are planted with short duration crops and they are maintained upto a certain period. Some of the combinations could be: mango interplanted with either papaya, pine apple, phalsa or straw-berry, and sapota interplanted with papaya, phalsa, pine-apple or straw-berry.

v. High density orchard developed with dwarfing root stock.

High density orcharding is a recent innovation. Greater number of plants are planted per unit area in certain crops like mango, citrus, apple, pear, walnut and others. Those plants are dwarfened by adopting certain horticultural techniques like use of dwarfing root stocks, use of growth retardants, regular pruning.

of the trees and such other practices. These dwarf trees can be easily handled and the income of the grower may be maintained steady. This system has also disadvantages like short life span of the trees, and the adverse effect of root stock on the fruit quality.

vi. Dry orchard:

Dry orcharding is also a recent technology where hardy types of fruit crops like mango, sapota, ber, guava, custard apple, cashew and others may be planted by adopting certain moisture conservation methods like contour/trench planting, crescent bunding, mulching, etc. These methods facilitate easy initial establishment of the transplants.

What is a variety?

A variety is a group of plants which maintain their distinct morphological features when propagated sexually or asexually.

What are the pre-requisites of an orchard?

A good orchard should be well planned. It should have different blocks for different types of trees, a good source of water for irrigation, properly laid out roads, wire fencing round the orchard, an attached nursery with facilities of plant house/potting shed and and store house.

## Why identification of crops and their varieties is necessary?

There are a number of varieties in almost all the fruit crops. The varieties differ in their morphological features, growth and flowering habits, potential for bearing, fruit quality and resistance/ susceptibility to different pests and diseases. It is, therefore, necessary that one should know the varieties to be able to select the required variety for planting. Since many varieties have synonyms, one can avoid duplication in planting of varieties if one has such knowledge. By planting the right variety, one can expect to harvest a good crop.

## 1.3 Precautions:

- Fix the exact date and time of visiting to the orchard and inform the manager of the orchard well in advance of the visit.
- Check up the transport availiability before the programme is chalked out.
- Make sure what you are required to study in the orchard during the visit.
- Avoid plucking/pinching/multilating any crop plant in the orchard.
- Take care to observe critically the difference among the varieties/hybrids.
- Collect the required plant specimens for identification only after you are permitted to take.

## 1.4 Materials required

- I) Note book and pencil
- ii) Knife
- iii) Secateur
- iv) Paper/polythene bags with rubber bands
- v) Magnifying glass
- vi) Teasing needle
- vii) Lunch/food packet

## 1.6 Procedure

- Follow the leader of the visiting team and conduct the visit in an orderly manner as the man-in-charge of the garden takes the visiting team round the orchard.
- Listen carefully while the details of the orchard are explained.
- Note down all the points as the details of the orchard are furnished.
- Note down all the details of the orchard on varieties of crops grown and their description in brief.
- Organise the recorded information for recording as observations.

## 1.6 Observations

(a) The pupil should record the following observations in the given table.

1. Name of orchard/location

ii. Name of owner

iii. Date of visit

iv. Type of soil

| Sl. No. | Names of different fruit crops | Varieties/ hybrids under each crop | Brief description of the varieties or hybrids | Facilities available in the orchard | Remarks |
|---|---|---|---|---|---|

(b) The pupil will also draw the plan of the orchard indicating the different components.

1.7 Expected behavioural outcome

The pupil acquires the following abilities to:

Grade

- identify the different fruit crops and their varieties;
- record the relevant information about different varieties of fruit crops;
- understand the plan and planting of an orchard;

- understand the general problems in the orchard management and possible measures to solve them.

The teacher should evaluate the pupil for the above abilities.

1.8 Questions

i. What is an orchard and what are different types of orchard?

ii. What are the advantages and disadvantages of any two types of orchards?

iii. What do you mean by dry orchards? What steps would you take in establishing them?

iv. Give certain suitable crop combinations in mixed orcharding.

v. What steps would you take in establishing a good orchard?

vi. Check the most appropriate answer:

i) Mixed orchard with varieties of the same fruit may be preferred because of:

a) Assured yield every year
b) Low risk
c) both (a) and (b)
d) None

ii) The major disadvantage of mixed orchard is:

a) Marketing the produce
b) Poor economy
c) Difficult intercultural operations
d) All the above

iii) In a high density orchard, the root stoc should impart to scion:

a) Low vigour
b) High vigour
c) No effect on vigour
d) High yield

iv) In dry orchards, the emphasis should be on:

a) Conservation of soil moisture
b) Planting of hardy plants
c) Both (a) and (b)
d) None

vii. State whether the following statements are true or false. Round off the correct answer.

a) Morphological characters do not change in a variety T/F

b) Apple tree is self compatible T/F

c) Root spread and distribution are important considerations in selecting a fruit tree for a minted orchard T/F

d) Control of pests and diseases in mixed orchard is easy. T/F

## 2. Activity Unit: PLANTING OF FRUIT PLANTS (MANGO, BANANA, PAPAYA AND LIME)

### 2.1. Instructional objectives:

The pupil should be able to:

- Know the methods of planting;
- know what is planting;
- know when to plant fruit plants;
- practice the planting of the above listed plants.

### 2.2 Relevant information

- What is planting:

Planting consists of transferring young plants from nursery beds or pots to their permanent place in the orchard.

- When the fruit plants should be plated?

The season of planting varies with different crops and local conditions. There are two seasons of planting in vogue in India:

(i) Monsoon (July-August) or September-October after the heavy rainfall; and

(ii) Spring (February-March)

Monsoon season is considered to be the best for planting for most of the fruit plants. Planting in February is preferred especially where the irrigation is assured and inexpensive. This gives the plant an early start.

- Why the fruit trees should be planted during monsoon and spring only?

Planting early in the rainy seas.n enables better establishment and vigorous growth. At the end of the rainy season, roots would have spread well and frequent irrigation would not be necessary. Scuh trees will withstand the heat and dry winds in a much better way.

Trees planted in spring, establish roots in summer, start growing as the weather warms up and during the rains, they put out good growth.

- Why it is necessary to plant the fruit trees at a particular planting distance?

Planting distance varies with the kind of fruit plant depending on many factors like tree size at maturity, type or fertility status of the soil, rainfall and availability of irrigation water.

If trees are planted too close, they grow tall and slender without proper spread. They are more liable to injury by strong winds. Cost of picking the fruits, spraying and pruning are also more in the case of tall trees. Closely planted trees bear inferior quality and poor sized fruits with low yields.

- Which are the different systems of planting fruit crops?

The fruit plants can be planted in the field by adopting any of the systems viz., (1) Square,

(2) Rectangular, (3) Quincunx, (4) Triangular, and (5) Contour.

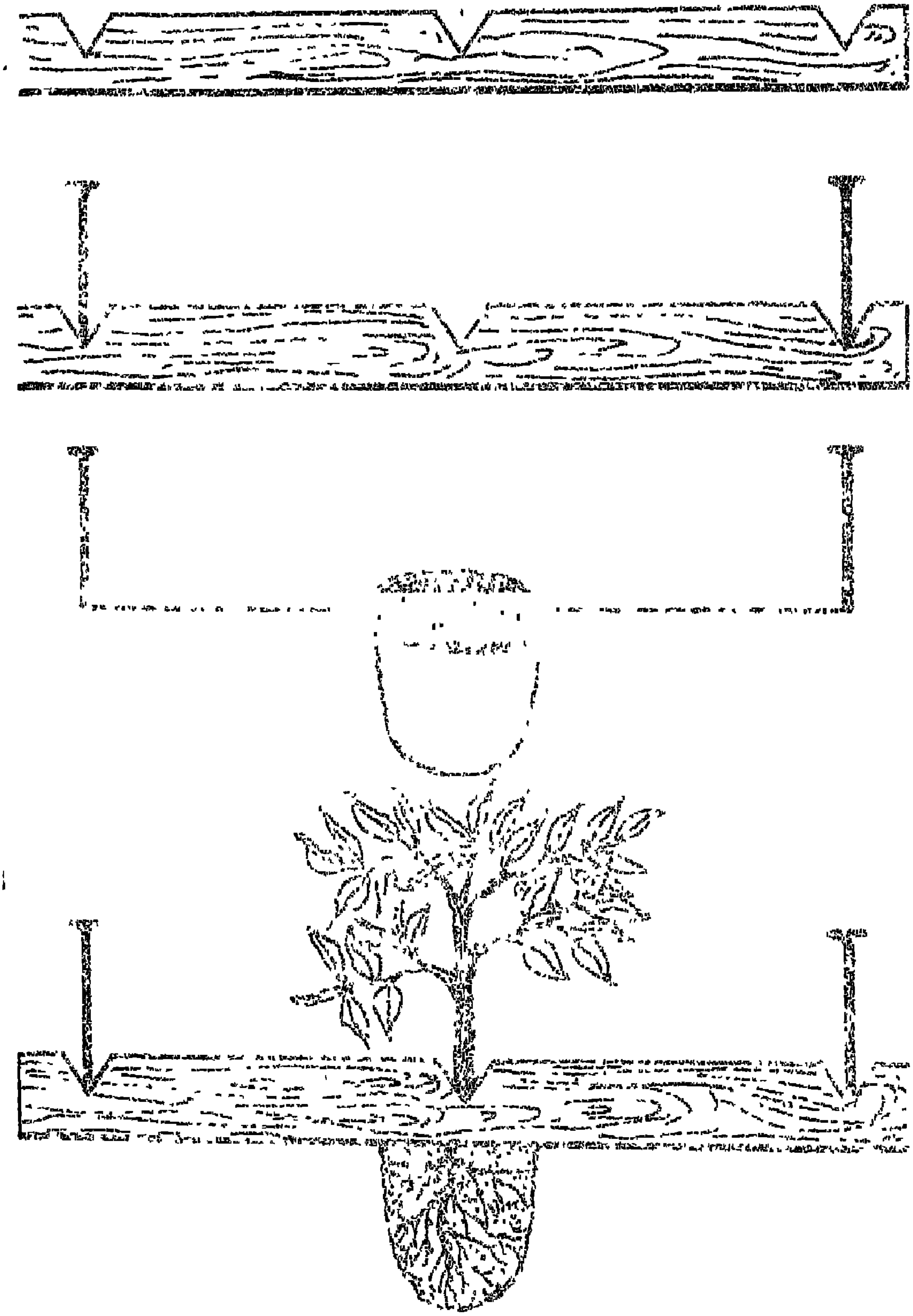
The square and rectangular systems of planting are usually adopted as these are easy to lay out and allow sufficient room for orchard operations.

## 2.3 Precautions

- Choose the appropriate season of planting for better establishment.
- While planting face the heavily branched side towards the prevailing wind.
- Set the plants in such a way that the bud union remains slightly above the ground level.
- Plant the trees as deep as they stood in the nursery or pot.
- Take care not to disturb the root system as far as possible.
- Irrigate the trees soon after planting.
- Provide stakes in windy situations.
- Plant during the cool hours.

## 2.4 Materials required:

i. Spade
ii. Khurpi
iii. Planting board
iv. Wooden pegs
v. Chain/coir



PLANTING WITH A PLANTING BOARD

vi. Planting material-mango grafts, ban suckers, papaya seedlings, Kagadi l seedlings.

2.5 Procedure:

Note: It is assumed that the planting plan h been made, land is prepared, stakes ha been fixed, pits have been dug and fil

- Place the planting board in such a manner t the centre notch of the board is in the pos of marking peg.
- Drive in the pegs at each end of the board,
- Remove the planting board now as well as th marking peg.
- Dig a hole with the help of a khurpi, large to receive the plant with a ball of earth, the planting mark stands.
- Place the plant (graft/budding/seedling/sucl with ball of earth in the pit.
- Bring back the planting board in such a mann that the two pegs (guide pegs) at both ends with the notches of the board. With the hel these guide-pegs adjust the position of the The plant should occupy the same position wh was occupied by the marking peg.
- After adjusting the position of the plant, c the depth of the plant.

loose soil around the plant and press with the help of a khurpi handle.

- [illegible] the pit to the ground level.
- Fix a suitable stake at about 10 cm on the windward side of plant and fasten the plant to the stake loosely with jute string.
- Make a small basin around the plant and irrigate it.

### 2.5.a Planting mango grafts

- Break the pot without disturbing the roots.
- Plant with ball of earth intact keeping the graft joint well above the soil.

### 2.5.b. Planting banana suckers

- Select only sword suckers (plants with thick stem and narrow leaves)
- Prepare pits of size 50 cm cube at spacing of 1.8 x 1.8 m. for Dwarf Cavindix and of 2 x 2 m for Robusta variety.
- Prepare suckers for planting as below:

  Cut off pseudostem leaving 20-25 cm stem.

  Cut off old roots, and pare off the outer surface of sucker.

  Dip sucker in a slurry and sprinkle 10 g carbofuron granules per sucker.

### 2.5 c Planting papaya seedlings

- Select 5-6 weeks old seedling.

- Remove seedling from polybag/pot with roots intact.
- Remove/pinch off leaves retaining only 3-4 leaves.
- Plant 2 seedlings per hill.

### 2.5.d. Planting lime seedling

- Prune some of the old roots and shoots if planted bare-rooted.
- If planted with ball of earth intact, prune only some shoots to reduce transpiration.

### 2.6 Observations

The pupil should record the observations as per the following table:

| Sl. | Items | Fruit crops | | | | Remarks |
|---|---|---|---|---|---|---|
| | | Mango | Banana | Papaya | Lime | |
| 1. | Date of trans- planting. | | | | | |
| 2. | Number of plants planted | | | | | |
| 3. | Number of plants established | | | | | |
| 4. | Percentage establishment of plants (one month later, record) | | | | | |
| 5. | Time taken for the new flush. | | | | | |

### 2.7. Expected behavioural outcome:

Pupil acquires the abilities to:

Grade

- know why proper planting is necessary;
- decide the correct season for planting;
- know the correct method of planting the four kinds of fruit plants.
- actually plant the plants.

### 2.8 Questions:

i. What is planting?

ii. What are the main seasons for planting of fruit trees? Explain.

iii. Why planting board is necessary?

iv. What are the different systems of planting of fruit plants?

v. What are the precautions to be kept in mind while planting?

vi. How do you plant the graft of a mango?

vii. How do you prepare a banana sucker for planting?

viii. Compare the method of treatment of roots and shoots while planting a mango graft and a papaya seedlings.

ix. Fill in the blanks with appropriate words:

1. Two main seasons for planting fruit plants are______________and____________________

2. In areas with irrigation facilities, the best planting time is ____________________

3. The planting system with maximum number of fruit trees per unit is ____________

x. Match the following pairs:

| | | | |
|---|---|---|---|
| 1. | Close planting | A. | Best planting time |
| 2. | Planting system | B. | Unsuitable for planting |
| 3. | Monsoon | C. | Poor quality fruit |
| 4. | High harvesting cost with | D. | Tall trees |
| 5. | Summer | E. | Contours |

## 3. Activity Unit: LAYING OUT DIFFERENT SYSTEMS OF IRRIGATION FOR YOUNG AND ADULT TREES.

### 3.1 Instructional objectives:

The pupil should be able to:

- know the different layout methods for irrigation and their merits and demerits;
- know the difference in the methods of irrigations of old and young trees;
- know the units of irrigations;
- know the soil characters in relation to irrigation;
- actually practise different irrigation methods.

### 3.2 Relevant information:

- Plants lose water by transpiration. To produce one pound of the dry matter, water loss by transpiration from a plant may range from 110 kg to 550 kg. In addition, water is lost from the soil by way of evaporation.
- Water requirements vary widely among different crops, seasons, soil conditions and methods of applications.
- The aim of irrigating a fruit crop should be to wet the entire root zone without any wastage of water.
- Some plants need regular irrigation (banana, papaya, grapes) and some need protective irrigation in early stages of growth (mango, sapota, etc.)

- The common methods of irrigations generally followed are flood irrigation, (in basins), furrow irrigation. Some of the recent systems are sprinkler, drip and sub-soil irrigation. The system of irrigation to be followed depends upon the soil type, topography, quality of irrigation water and such other factors. While the flood/basin type and furrow type systems result in wastage of water, the other recent systems allow economy in the usage of water. Added to this, the latter systems provide certain other advantages like check in the soil erosion and weed growth.
- Before irrigating a crop, matters like when to irrigate, how much to irrigate and where to irrigate are required to be thought over. One can get an idea of the needs of the trees for water by their external symptoms of drooping of foliage or by assessing the level of available soil moisture in the soil. It is always advisable to irrigate the crop before the critical levels are reached such as permanent wilting point of the soil.
- It is also necessary that the pupil should know certain critical stages for irrigations such as initial growing period of transplants, fruit set; fruit development. The young transplants need

to be cared more than the older trees. The irrigation water should not be saline since many fruit crops tolerate only low level of salinity of soil/irrigation water. It is also necessary that the student realises the quantity of irrigation required to be given.

3.3 Precautions:

- Since irrigation cost is often the largest item in orchard management, the irrigation methods have to be properly devised.
- Decide irrigation method in accordance with the varying orchard conditions.
- Know in advance the water requirement of a crop grown under the existing situations so that adequate quantity of water is made available or ensured.
- Know the quality of water available.
- Know the soil properties to decide the irrigation method.
- Know the drainage capability of the soil.
- Know salinity or other problems.
- Know the critical timings when irrigations are required to be given necessarily.

3.4 Materials required:

i. Screw auger

ii. Core sampler

iii. Tube auger
iv. Tensiometers
v. Gypsum blocks
vi. Physical balance
vii. Moisture cans
viii. Pipe liner
ix. Rubber hoses
x. Tools like spades, crow bars etc.

## 3.5. Procedure:

### i. Flood method:

Follow this method when the topography is flat and level. Citrus orchards and vine yards are some times flood irrigated.

### ii. Furrow irrigation:

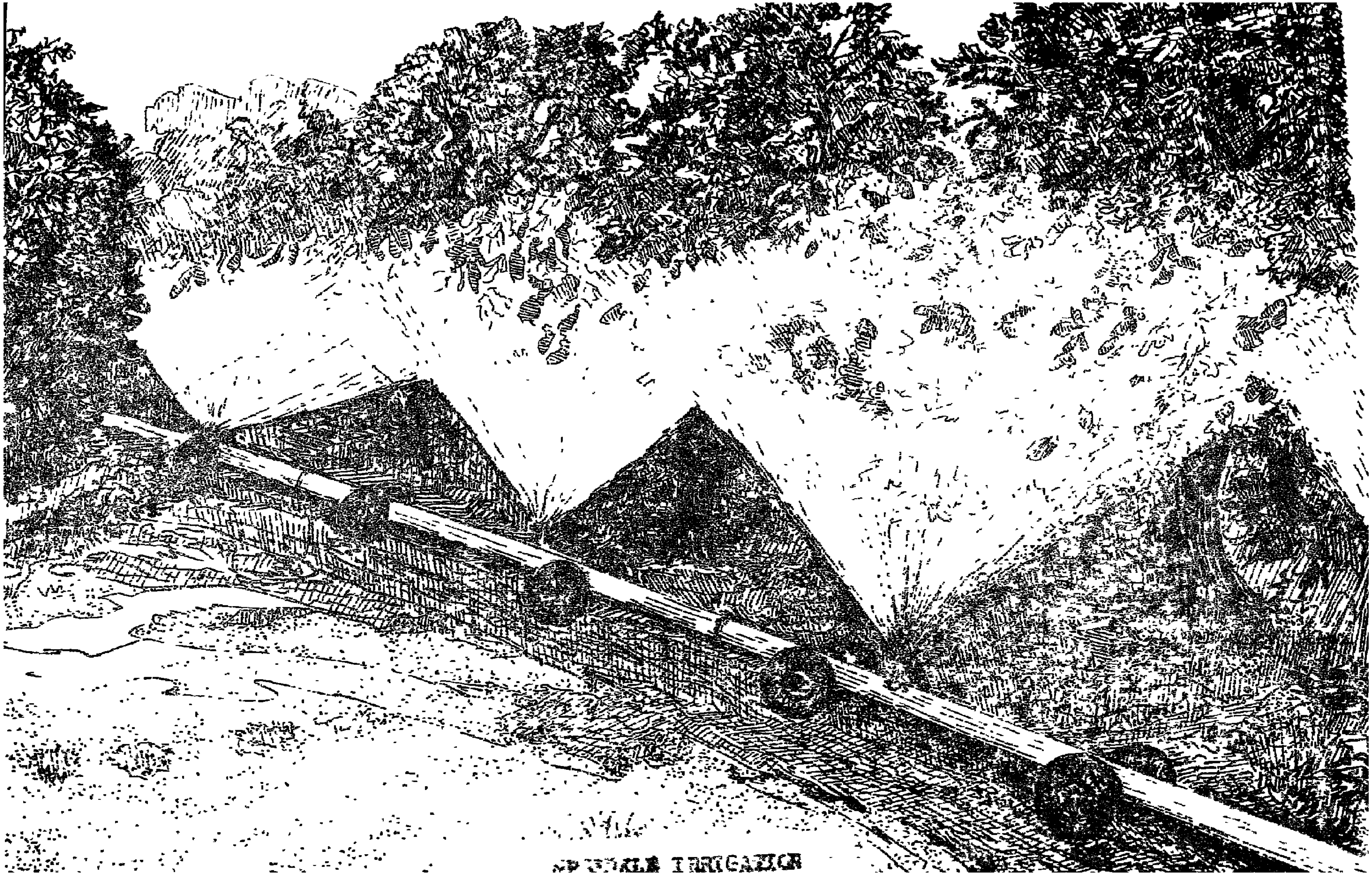
Allow water into the furrows rather than wide checks. This method is followed in row crops.

Allow water to flow in the furrow for sufficient time, so as to percolate across the bed and wet the surface. For row crops, develop furrows 20 to 30 cm deep. A single furrow or more furrows may be formed.

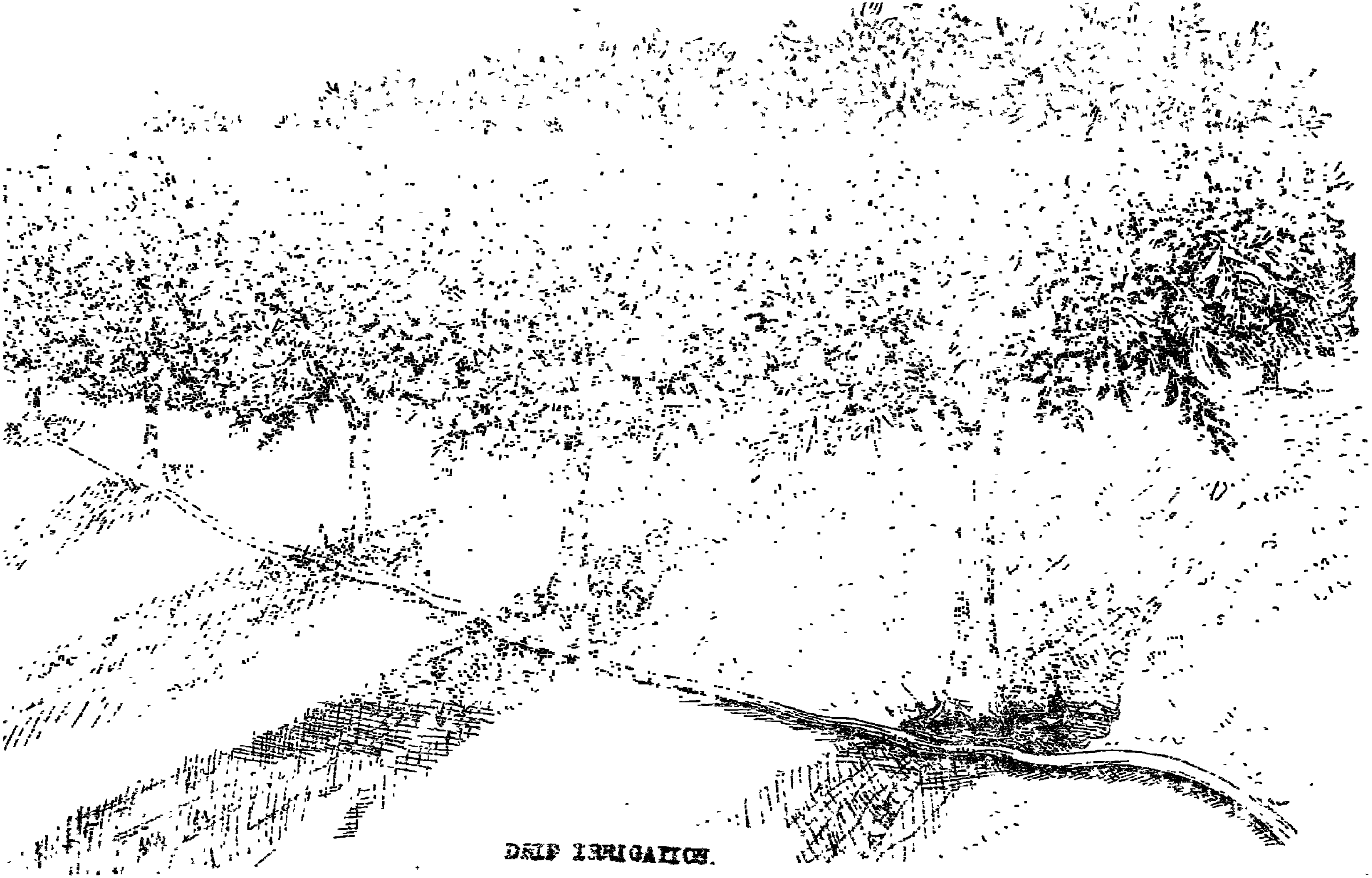
### iii. Basin method:

Form a basin around each tree in the form of a square or a circle. Avoid water coming in contact with the tree trunk by putting a bund or mound close to the trunk.

[illegible]



SPRINKLE IRRIGATION



DRIP IRRIGATION.

Follow this method when flood or furrow irrigation is not possible. Restrict this to [illegible] value crops and in undulating lands.

v. Drip irrigation:

Allow small amounts of water to trickle slowly into the soil through mechanical devices called emitters wetting the soil at limited locations. The emission rate ranges from 2 to 8 litres per hour/day. The total quantity/per day would depend upon the needs of the tree.

## 3.6 Observations:

The pupil should take and record the following observations:

i) Determination of soil moisture content by gravimetric method.

ii) Determination of field capacity

iii) Determination of permanent wilting point.

iv) Use of tensiometers for scheduling irrigations.

v) Use of gypsum blocks for scheduling irrigation.

vi) Measure the quantity of water required for irrigating crops like banana, grape under the given situation.

| Sl. No. | Name of crop/ variety. | Age of the plant/ tree | System of irrigation given | Area to be covered with water |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| Irrigation in acre inch given | Canopy of the tree | Texture | Maximum water holding capacity | Permanent wilting point. |
|---|---|---|---|---|
| 6 7 | 7 | 8 | 9 | 10 10 |

## 3.7 Calculations

i) Moisture percentage = PW

$$PW = \frac{WS_1 - WS_2}{WS_2} \times 100$$

$WS_1$ = Weight of fresh soil samples (before oven drying)

$WS_2$ = Weight of soil samples after oven drying at 100 C

ii) Acre inch = One acre-inch is a volume of water covering an area of one acre upto a depth of 1". The volume of the water is 3630 cubic feet. This is equivalent to 27133 gallons.

## 3.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | Grade |
|---|---|
| - know different methods of irrigation; | |
| - know precautions to be taken while irrigating; | |
| - understand irrigation measurement units; | |
| - know special equipments required for irrigation; | |
| - diagnose the needs of plants for irrigation; | |
| - practise different methods of irrigation. | |

The teacher should evaluate the pupil for the above abilities.

3.9 Questions:

i) Name the different methods of irrigations followed in orchards.

ii) What methods of irrigation will you follow for the following crops, viz., citrus, mango, banana, grape, and pineapple.

iii) Name the methods to be followed under two situations:

(a) When water is available in plenty

(b) When water is available in small quantities

iv) How do you decide the irrigation intervals of an orchard crop?

v) What are advantages and disadvantages of drip and sprinkler irrigation systems?

vi) What are the problems, you will come across when flood irrigation is followed in an orchard?

vii) What is field capacity?

viii) What precautions will you observe while irrigating young and adult trees?

ix) State whether the following statements are true or false. Round off the correct answer.

a). Water holding capacity of the soil has a bearing on the frequency of irrigation in an orchard. True/False.

b) Water requirement for all fruit crops is one and the same.

True/False

c) In irrigating a fruit crop, one has to avoid water stagnation at the root zone.

True/False

d) Fruit setting is a critical stage as far as water requirement is concerned.

True/False

e) Gypsum blocks and tensiometers are employed in assessing the soil moisture status of an orchard.

True/False

f) We need more water for irrigating fruit plants by way of drip irrigation.

True/False.

g) It is advisible to avoid using saline water for irrigation.

True/False

h) Sprinkler irrigation calls for a high initial cost.

True/False.

## 4. Activity Unit: TRAINING OF MANGO, CITRUS, GUAVA, SAPOTA, POMEGRANATE AND FIG.

### 4.1 Instructional objectives:

The pupil should be able to:

- know the purpose of training;
- know the different systems of training;
- know the stage of the crops when training has to be actually initiated;
- perform actual training in these crops.

### 4.2 Relevant information

**What is training?**

Training is an operation by which the plant is made to develop an orderly framework or structure. This is achieved by staking, tying, supporting, propping, trellising or spreading on pergola with or without pruning of plant parts. This is usually done when the plants are young.

**Why are fruit plants trained?**

1. For building a strong framework for the tree with broad crotches.
2. For providing a definite shape to the tree.
3. For building a well shaped canopy.
4. For enabling easy cultural operations.
5. To avoid incidence of soil borne diseases.

## Training in some fruit crops:

### Mango

It is a large sized tree with a heavy top. Strong framework is necessary because it can produce heavy crops. By nature, it assumes a graceful, dome shapped form. The young grafts should be allowed to grow unhampored for four years and they are trained to a high head with modified leader system.

### Citrus

The shape, size, spread vary in each species and they are trained to a single stem upto a height of 45-60 cm from ground level. The mandarin trees assume a dome shape while lemon trees remain irregular. They are trained to high or low head with modified leader system.

### Guava

It develops into a bush like tree. A clean and straight trunk is to be maintained upto a height of 60-90 cm from ground level. Three or four strong and well grown branches radiating from the trunk on all sides need to be encouraged, giving the tree a vase or goblet shape.

### Pomegranate

Plants are allowed to grow in a bush form with several main shoots arising at ground level. In course of time, the plant becomes too bushy. It is advisable to train the tree to a single stem at first and [illegible] 3-4 branches are allowed. The desired shape [illegible] after 2-3 years of planting.

**Sapota**

It is a slow grower and the branches [illegible] whorls. In air layers, branches appear very close to ground thus hampering the cultural operations, but they help in building or thickening the central stem. It is trained to low head and to modified leader. The basal and over-crowding branches need to be removed otherwise they become unfruitful.

**Fig**

It develops into a bush but it is desirable to train to a single stem with well distributed limbs in the first year itself and head back at a height of 120 cm from ground. In general, 6-8 side shoots are encouraged 45 and 120 cm from the ground level.

In certain parts of the country, bush type of training is common with 6-7 main branches on the trunk.

## 4.3 Precautions:

- Handle the newly planted grafts or budlings carefully, otherwise they may be damaged while training.
- Select suitable and strong stakes only for supporting.
- Avoid a ny the unwanted branches on the main trunk.
- Paint the wouds with proper fungicides or wax.
- Avoid removal of scaffold branches unnecessarily.

### 4.4 Materials required :

i. Suitable stakes.

ii. Tying material such as sutali (gunny or coconut string).

iii. Metal or wooden hammer for fixing stakes in the ground.

iv. Melted coal tar to paint the basal part of stake to avoid termite attack.

v. Sharp grafting knife or secateur.

vi. Heptachlor for dusting the soil at the base of the stake to avoid termite attack.

vii. Practical note book and pencil to record the observations.

### 4.5 Procedure :

- Record the number of plants/trees requiring training.
- Select the required number of strong stakes for supporting the young plants.
- Give a coating of coal tar to the stake base to be fixed in the soil.
- Fix the state firmly close to the plant and secure the plant, then stake gently with the help of a thread.
- Cut the low lying branches wherever necessary in the already established plants to give a clean stem upto certain height.
- Remove the weak shoots/branches to encourage strong scaffold branches for the tree.

4.6 Observations: The pupil should record the following observations in the table given below:

| Sl. No. | Fruit crop/s trained | Type of training carried out | No. of plants/ trees trained under each fruit crop | No. of scaffold branches allowed to remain |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| Growth parameters (height, stem, girth, canopy spread etc. recorded at regular intervals after initial training | Future yield from individual trained tree |
|---|---|
| 6 | 7 |

## 4.7 Expected behavioural outcome:

The pupil acquires the following abilities to:

- understand the meaning and importance of training in fruit trees;

- distinguish the different types of training followed in fruit trees;
- distinguish the trained and untrained fruit trees;
- decide a particular type of training for a particular fruit tree;
- make out the merits of training given to fruit trees over those left to themselves;
- make out the defects in the already trained tree and set right the mistakes;
- actually perform the operation of training in different fruit crops.

Grade

The teacher should evaluate the pupil for the above abilities.

4.8 Questions:

1. What is training and why are fruit trees given training?

ii. What are low and high head systems and under what climatic conditions they should be preferred?

iii. What are weak and strong crotches? what is the advantage of having wide angled branches?

iv. What are central leader, modified leader and open centre systems of training? List out their merits and demerits with suitable examples.

v. What is the importance of even distribution of branches on the tree?

vi. Why do basal branches in sapota become unfruitful after a few years of planting?

vii. List out the differences in training of adult ~~and~~ nursery plants with regard to fruit crops such as citrus.

viii. Whether the fruit trees of evergreen or deciduous nature require more systematic training?

ix. What is the basis for training orchard trees to a particular shape?

x. What precautions are necessary while training a fruit tree?

xi. Under-line the Most appropriate answer:

1. Training of fruit plants aims at:
   - a) Developing a good framework.
   - b) For early yields.
   - c) Controlling pests and diseases.
   - d) None.
2. The basal shoots in sapota turn out to be unfruitful. The reason may be -
   - a) They are nearer to ground.
   - b) They do not get enough light.
   - c) They are prone to pests and diseases.
   - d) They do not get sufficient nutrients.
3. Improper training of fruit plants may result in:

   a) Weak crotches, b) Strong crotches,

   c) Without crotches d) None.

4. The system under which mandarin trees are trained: a) Open centre b) Modified leader c) Central leader, d) No training is essential for citrus.

5. Even distribution of branches of a fruit crop is essential because:

   a) It avoids shading of branches.

   b) It minimises pests and disease attack.

   c) It makes harvesting easy.

   d) Pest control becomes very easy.

---

## 5. Activity Unit: TRAINING OF GRAPE ON BOWER AND HEAD SYSTEMS.

### 5.1 Instructional objectives:

The pupil should be able to:

- know the principles of training in grapes;
- know the different systems of training in grapes;
- know the difference between Bower and Head systems of training and advantages and disadvantages of each system;

### 5.2 Relevant information

**What is the purpose of training:**

Proper training in grapes is essential for higher production. The type of training varies with the variety. The different purposes of training are:

1. Training provides a good framework.
2. Ensures systematic distribution of the vine growth.
3. Facilitates management of the vines.
4. Helps to develop and properly stake canes which would bear bunches.
5. With the proper spreading of the vines, the growth is exposed to adequate sunlight and eration and thus the disease incidence is minimised.

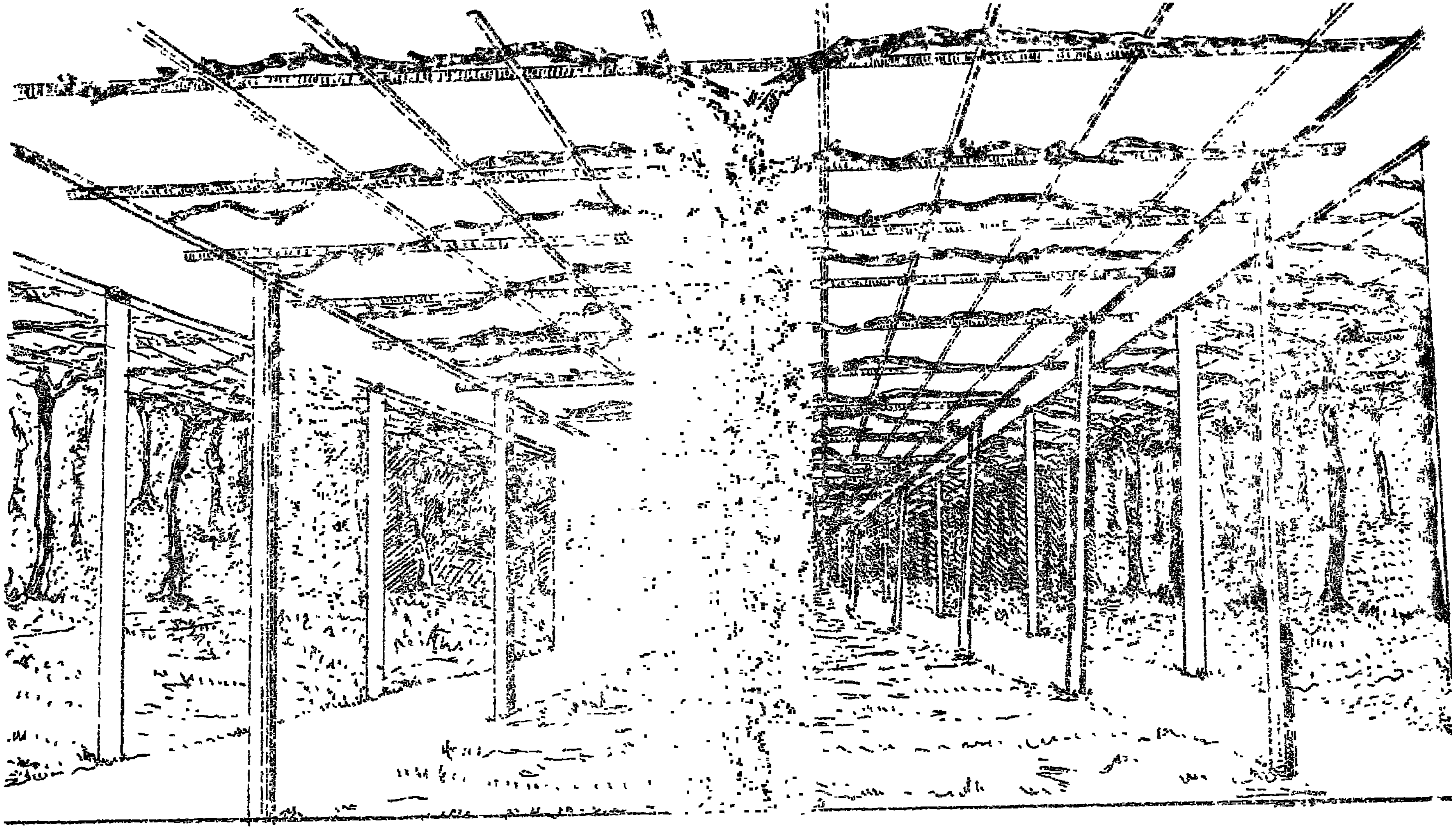
- What is Bower system of training?

Bower system is suitable for vigorous varieties with pronounced apical dominance accompanied with high yields. This method is recommended for varieties such as 'Anab-a-Shahi' particularly and also for other varieties like Thompson Seedless and Bangalore Blue and Muscat. The fruit clusters remain well protected from birds and jackals. In North India, this system helps protecting the vines from hot winds and dust storms in summer. It is however, more expensive method requiring heavy initial investment.

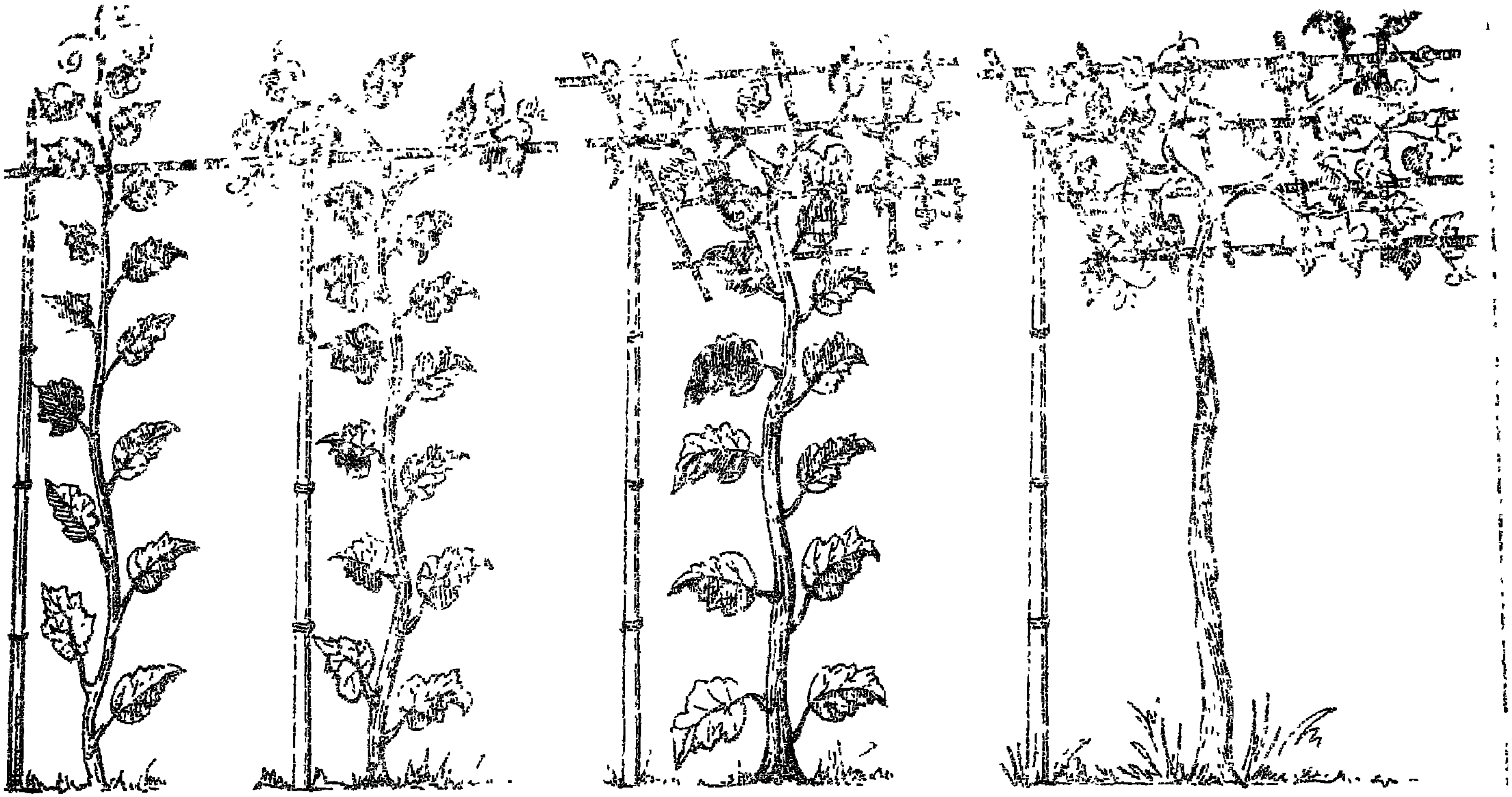
The main features or the Bower system is that the vines spread on the wire netting supported by stone pillars. The vertical shoot is headed back when it reaches the bower and two lateral shoots are encouraged to develop into two arms taken one on either side of the trellis. Secondary branches are maintained at 60 cm apart on these primary arms.

- What is Head system?

- The Head system is commonly followed in varieties which are not vigorous and bear branches on the basal few buds of the canes. This method is recommended for varieties such as Beauty Seedless, Pusa Seedless, Parlette and Muscat (Gulabi). It is easy and much less expensive to develop and maintain. The cost of temporary supports to be provided is less and the



BOWER SYSTEM OF TRAINING



DIFFERENT STEPS IN TRAINING UNDER BOWER SYSTEM

vines support themselves after a few years. Cross-cultivation of the area is possible and weeds are controlled easily. But the yields are low owing to small cropping area nearer the head, and the fruits are subjected to sunburn-injuries in seasons or very high temperature and low humidity.

In the Head system, plants are planted closely. The vine is topped at 1 m above ground level and two lateral branches are encouraged and the plant is toppe again at 1.3 m encouraging two more laterals. These are allowed to grow to a length of 45 cm and fruiting canes are developed on these laterals. Usually, live stakes of Erythrina india or Commiphora beryri are used. The vines become self-supporting after a few years.

## 5.3 Precautions:

a) For Bower System of Training:

- Select, retain and take care of the best growing shoot and allow it to grow straight on the stake provided, until it reaches the bower.

b) - Take care to remove the auxillary shoots.

- Take care to pinch off the growing tip at 15 cm below the Bower level.
- Take care to allow only two shoots arising from below the cut end, and allow them to grow in opposite directions on the wires overhead.

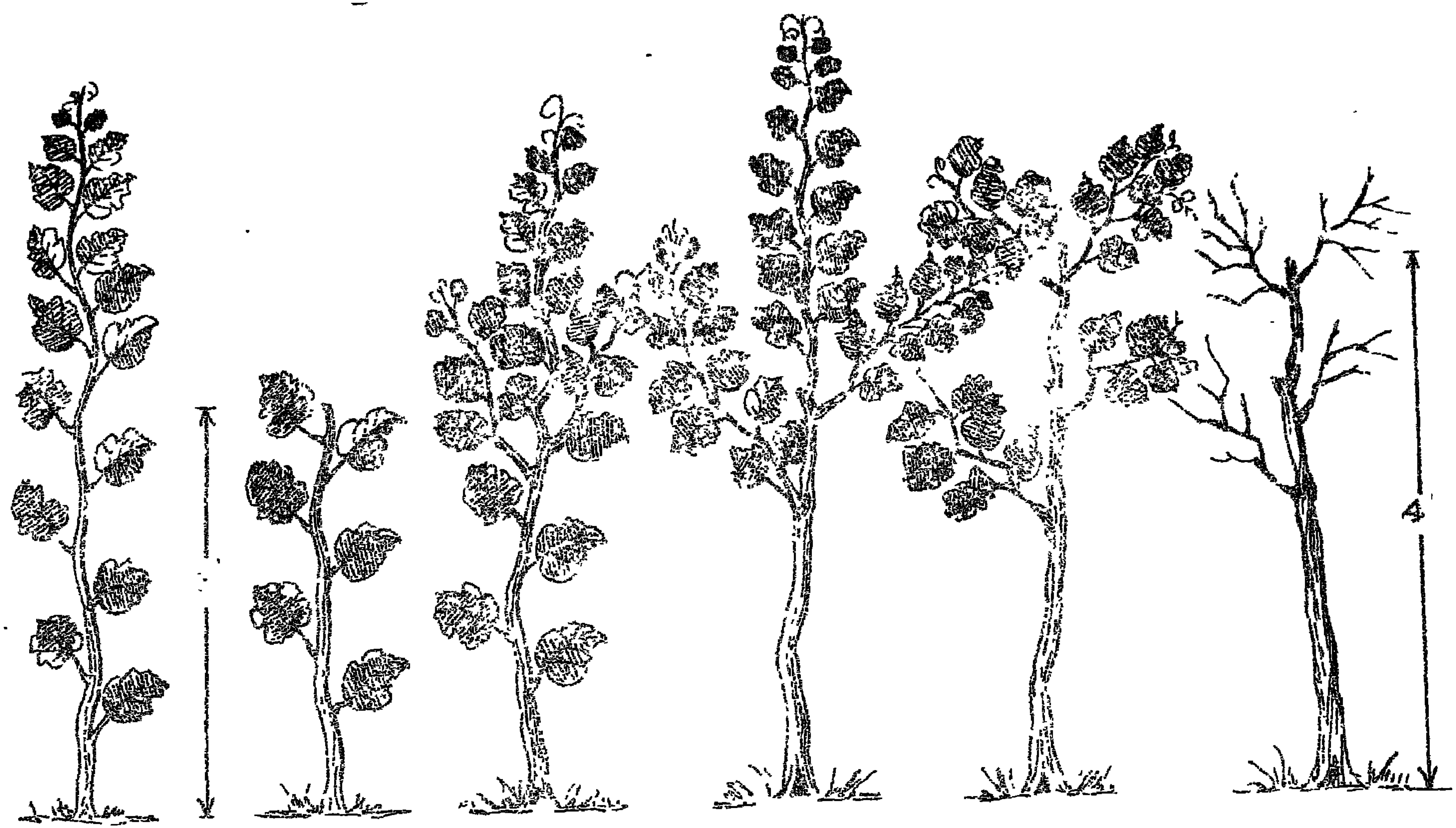
- Take care to allow side shoots to grew on these arms at regular intervals of 45-60 cm or 60-75 cm, depending on the weather conditions of the growing region.
- Take care of the shoots from these secondaries and the canes on them to be distributed uniformly all over the Bower in stages.
- Take care not to let loose the canes but to tie to the wire trellis with banana firbe.

b) For Head System of Training

  - Take care to see that the plant is topped at 1 m above the ground level.
  - Take care to allow only 2 laterals to develop from and top them at a height of 1.3 m.
  - Take care to see that 2 more laterals are allowed to develop from them.
  - Take care to provide suitable live-stakes and tie the plants.
  - Take care to retain the stakes till the trunks become thick and self-supporting.

5.4 Materials required

1. Suitable stakes.
ii. Tying materials such as banana fibre
iii. Crow bar for making holes to fix the stakes.
iv. Secatour or grafting knife for removing the unwanted plant parts.


4

[illegible]

v. Record Book and pencil to note the day's operations, number of vines attended and the man-hours required for the work.

5.5 Procedure:

- Carry the stakes and place one for each vine.
- Fix the stakes firmly in the soil and in erect position.
- Tie the plants to the stake at regular intervals from the base to the tip, and in the case of Bower System the arms above must be tied to the wire trellis with bana fibre.

5.6 Observations:

- Record the differences between the Bower and Head System in respect of height of plant or top and number of arms on each vine.
- Record the nature of framework, growth and spread of the arms.
- Observe the spread of the framework, amount of bearing wood, and bearing capacity of the vines.
- Observe the difference in staking material used in Bower and Head systems of training.
- Draw figures to illustrate the different stages of training Bower, Trellis and Head Systems.
- Work out the expenditure to be incurred for the three systems of training.

## 5.6 Expected behavioural outcome

The pupil acquires the following abilities to:

Grades

- understand the meaning and importance of training in grapes:
- distinguish the difference between Bower and Head system of training;
- find out the merits and demerits in Bower and Head systems of training;
- recommend specific system of training based on varieties.

The teacher should evaluate the pupil for the above abilities.

## 5.8 Questions:

i. Why is training necessary in grapes?

ii. Why is Bower system of training recommended for varieties such as Anab-e-Shahi and Bangalore Blue, and Head System for varieties such as Beuty Seedless?

iii. Which of these two systems of training is easy and less expensive, and why?

iv. In which type of training the cultural operations can be performed easily?

v. Under South India conditions, Bower System of training is recommended to varieties such as Anab-e-Shahi and Bangalore Blue. What reasons would you attribute for this?

vi. What are the merits and demerits or Bower and Head systems of training?

vii. Select the most appropriate answer:

1. Vigorous varieties of grapes should be trained on:

a) Head System

b) Knitting system

c) Bower System

2. Beuty seedless or Gulabi (Muscat) variety of grapes is best trained on:

a) Head System.

b) Bower System.

c) Knitting System.

3. Two most important limiting factors in Bower System are:

a) High initial cost

b) Low yields

c) Poor quality produce

d) Need for skill.

4. Grapes grown under Head System gives:-

a) High yields

b) Low yields

c) High quality fruits

d) Low quality fruits.

## 6. Activity Unit: PRUNING OF GRAPE VARIETIES

### 6.1 Instructional objectives:

The pupil should be able to:

- understand what pruning is and how pruning of grapes is different from that of other fruit plants;
- know the different systems of pruning in fruit crops, with particular reference to grape varieties;
- know the purpose of pruning;
- know the types of pruning and intensity of pruning required for different varieties under various agro-climatic conditions.
- undertake pruning operations

### 6.2 Relevant information:

What is pruning?

Pruning is a process of removing any vegetative part. It is necessary to have a clear understanding of different parts of the vine before taking up pruning. Pruning activity is done to concentrate the activity of the vine in the parts left after pruning and to induce sprouting of the fruitful buds located in the middle portion of the canes, which otherwise do not sprout. It is also done to reduce the number of bunches and to encourage vegetative growth to ensure fruiting in the following year.

Pruning is done once a year in North India in January to make the fruitful buds sprout but in South and Western India, pruning is done twice in the year (once in summer and again in winter).

Grape vines grow continuously without any dormancy in South India. Hence, by pruning in April (Summer) the vines are forced to have a rest period which helps in the fruit bud differentiation.

Grapes require systematic and regular pruning. Pruning time mainly depends on the rainfall and temperature and early pruning can be practised in places where winter is mild. In localities where winter is severe, early pruning may prove dangerour, as new growth is subjected to killing by frosts. But delayed pruning results in delayed sprouting of the vines which in turn delays the ripening of fruits. More canes are retained in vigorous vines as compared to less vigorous vines.

Types of pruning in grape varieties:

1) Summer pruning: This pruning is for vegetative growth and is called 'Foundation Pruning' or 'Back Pruning' and is done in April-May. Canes are cut back to 1-2 nodes for building up of the fresh vegetative growth.

2) Winter Pruning: This pruning is for fruits and is called 'Forward Pruning' and it is done during September-October. The mature (about 6 months old) current season canes are pruned. Entire leaves and green growth are removed.

a) Anab-e-Shahi and Bhokri are pruned to 5-7 buds.

b) Thompson Seedless to 10 buds.

c) Bangalore Blue to 4 buds.

d) Gulabi and Cheema Sahebi to 6 buds.

In South India, for varieties like Bangalore Blue, Pachadrakshi and Anab-e-Shahi, the vines are pruned twice and two harvests are made. In April-May instead of back pruning, the vines are given forward pruning only. Particularly, in Bangalore Blue, pruning is staggered to have fruits almost throughout the year.

## 6.3 Precautions:

- Make sure of the parts of the vine to be pruned.
- Make sure whether the pruning is for vegetative growth or for fruiting.
- Take care not to prune the vines too severely or too light. Retention of more canes on the vine results in heavy crop load and vice-versa.
- Take care to retain more number of canes in the vigorous varieties and less number in shy or medium bearing varieties.
- Take care to give light pruning to canes that are away from the trunk since they are more fruitful than those nearer to the trunk.
- Take care to prune the water shoots, green and immature canes as they are sterile.
- Take care to prune the thicker canes lightly as compared to the thin canes.

- Take care to prune the flat canes, canes with long internodes and those that taper suddenly to the base as they are not fruitful.
- Take care to prune weak canes to 1 or 2 buds.
- Take care to swab the cut wounds with suitable fungicide.
- Take care to collect and destroy the prunings at the end.

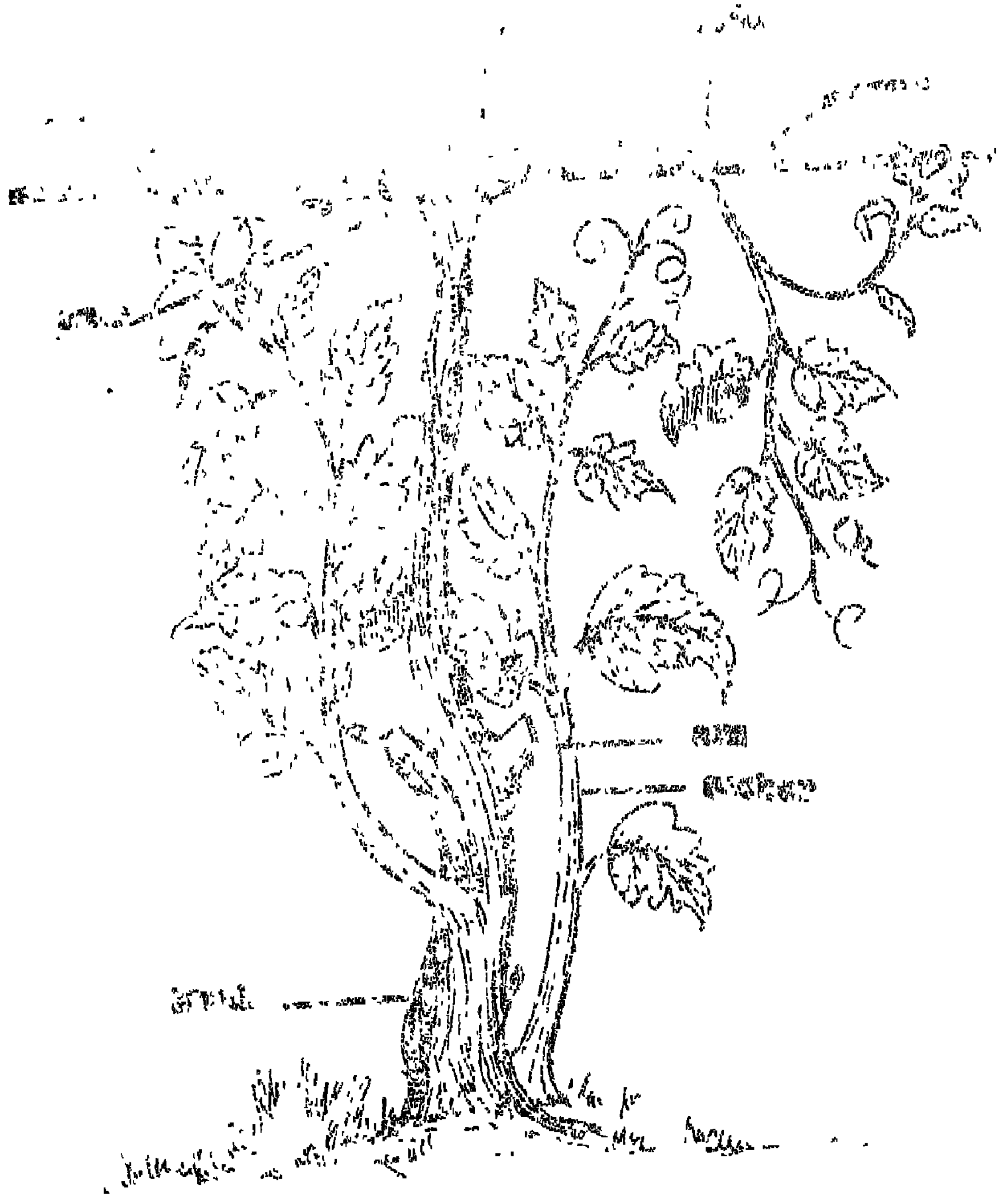
6.4 Materials required:

i. Secateur.
ii. Suitable fungicide mixed with water.
iii. Cotton wads for swabbing the cut ends with fungicide.
iv. Basket or a wheel barrow for collecting the prunings.
v. Banana fibre for tying the Deccan Davis and Torvaries to the trellis.

6.5 Procedure:

6.5.a For summer pruning:

- Remove all the suckers, water sprouts and tendrils with the help of secateur.
- Prune the canes to 1 bud or 2 buds.
- Swab the cut ends with cotton wool dipped in copper fungicide.
- Prune the vines at the right time most suitable for the locality.
- Withhold watering to the vines 1-2 days before pruning
- Cut and remove the dried canes.



DIFFERENT PARTS OF A GRAPE-VINE

6.5.b.For Winter Pruning:

This is more important than summer pruning. The number of nodes tobe retained depends on the variety. Since the pruning is a very crucial operation much care and precision must be exercised in pruning. Better seek the help and guidance of experts or experienced people.

- Decide the level of pruning for each variety based on 'bud analysis' under microscope for fruitfulness of buds.
- Prune the canes to 10 buds in Thompson Seedless and in others such as Anab-e-Shahi and Bhokri, prune to to 5 bud level.
- Retain more number of buds on thicker canes as compared to thinner ones.
- Prune only mature canes to the desired length.
- Swab the cut ends with suitable fungicide.
- Retain more canes on vigorous vines and less on less vigorous canes.
- Give severe pruning to vines that have given heavy crops in the previous season.
- Collect all prunings, leaves and bark peelings of the trunk and burn or bury them in a place away from the vine-yard.
- Spray all the vines with suitable fungicide and insecticide.

### 6.6 Observations:

The pupil should note and record the following observations:

- The differences between summer and winter prunings.
- The nature of plant growth (vegetative or re-productive) in different seasons.
- The difference between long caned and short caned pruning.
- The differences between light pruned and severely pruned canes in different varieties.
- The difference between unpruned and pruned vines with reference to plant growth, nature of framework, number of leaves and bearing capacity.
- The differences between the management of unpruned and pruned vines in terms of irrigation, plant protection and other cultural operations.
- The quality of fruits of both unpruned and pruned canes.

### 6.7 Expected behavioural outcome

The pupil acquires the following abilities to:

| | Grade |
|---|---|
| - understand the meaning, importance limitations of pruning in grapes; | |
| - distinguish between pruned and unpruned vines by their appearance or growth; | |
| - distinguish between the Back and Fore pruning methods; | |

- make out the difference in pruning grape vines under North and South Indian conditions;
- decide the pruning time for different regions;
- distinguish between the mature and immature canes on the vine;
- prune grape vines.

Grade

The teacher should evaluate the pupil for the above abilities.

6.8 Questions:

i. Why grape vines need systematic and regular planning?

ii. Where do flowers appear in grape vine?

iii. Even without pruning, grape vines can bear good yields, yet they require pruning, why?

iv. What are the 'Back' and 'Fore' prunings and when are they done?

v. Why are grape vines pruned only once a year in North India, while they are pruned twice in South and West India?

vi. What are the plant parts removed on the vine at pruning?

vii. Why some varieties are pruned with long canes while some others with short spurs?

viii. What are the foundation spurs and fruiting spurs?

ix. Why thicker canes are given light pruning compared to thinner ones?

x. Why pruning is not done at one particular time or month all over India?

xi. What is staggered pruning and in which varieties of grape is it followed? What is the advantage of staggered pruning?

xii. Explain the terms:

1. Summer pruning
2. Winter pruning
3. Water shoots
4. Sterile canes
5. Cane
6. Spur
7. Shoot
8. Sucker

xiii. More canes need to be retained at pruning on vigorous vines compared to less vigorous vines. Explain.

xiv. Partly mature, immature canes, flat canes and canes with long internodes should be pruned, why?

xv. A vine that has given heavy crop during the previous season, is to be pruned severely during the present season, Why?

xvi. Match the following pairs.

| | |
|---|---|
| i. 'Back pruning' or 'Foundation pruning. | a. Pruned to short spurs. |
| ii. 'Forward' pruning or 'Winter' pruning. | b. Vigorous variety. |
| iii. Anab-e-Shahi grape vine. | c. For vegetative growth. |
| iv. Bangalore Blue grape vine | d. For fruits |
| v. Vines pruned twice during the year. | e. South India |
| vi. Staggered pruning | f. Crop throughout the year. |

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## 7. Activity unit: PRUNING OF POMEGRANATE, PHALSA AND BER

### 7.1 Instructional objectives:

The pupil should be able to:

- understand the basic principle of pruning;
- understand the need for pruning;
- understand the correct stage or period of pruning in various crops;
- understand what to prune, where to prune and how much to prune;
- actually conduct/perform the operation of pruning in different fruit crops.

### 7.2 Relevant information:

Why to prune in pomegranate?

In pomegranate the fruits are borne terminally on short branches known as spurs. These are capable of producing fruits for 3 to 4 years. They need to be pruned to get the plant rejuvenated to produce new spurs for regular bearing.

Why to prune in phalsa?

If no pruning is done in phalsa, the plant grows into a tree with consequent reduction in yield. It needs to be pruned at regular intervals for production of fresh shoots which bear the fruits.

Why to prune in ber?

Pruning is ber is required not only in the early years to build a frame work, but also in the later

years

years to obtain economic yields. Fruits are borne in the axil of leaves on young growing shoots of the current season and therefore, regular pruning is necessary to induce fresh growth for bearing.

7.3 Precautions:

1. Prune at right time for shaping the plant or for production.
2. Do not resort to heavy pruning as it otherwise removes the vital parts capable of bearing fruits.
3. In pomegranate, remove the water shoots regularly.
4. Use always sharp knives or secateurs for efficient pruning.
5. After pruning treat the cut ends of shoots with a fungicide to avoid future incidence of diseases.

7.4 Materials required

i) Secateour

ii) Pruning Saw

iii) Pruning knife

iv) Copper fungicide

v) Fungicide

vi) Vessel to prepare the fungicidal paste.

7.5 Procedure:

7.5a Pomegranate:

Young pomegranate plants are required to be pruned for training into a single stem with a numbers of well distributed scaffold limbs. If the trees are required to be trained into a bush form, pruning of the plant should be so done with 3-4 main stems rising from the ground level. The suckers appear periodically and they should be removed.

The plant is topped at a height of 60 to 75 cm and the side shoots, 4 to 6 in number, well distributed along the main stem are allowed to arise starting from about 35 to 45 cm from the ground level. These selected shoots are also pruned after about 6 months when they have grown about 45 cm long, so that they become thick and stocky. The pruning of branches (removal of terminal portion) is repeated after 6 to 9 months. The plant gets the desired shape within 2 to 3 years of planting. In bearing pomegranate plants, 3 to 4 years old spurs which have lost the capacity to produce fruits should be removed. New spurs will appear and they will produce fruits.

Phalsa:

Severe annual pruning is essential to have new vigorous shoots to ensure regular and heavy fruiting. The bush should be cut back to 100-120 cm from the ground level. The new shoots will bear the fruits. Prune every year when the plants shed their leaves (during latter half of the winter season) allowing a frame-work of 100 to 120 cm above the ground level.

**Ber:**

Pruning is done in the early years to build a strong frame-work of the tree, and in the later years, to obtain profitable crops. The fruits borne in the axil of the leaf on the growing young shoots of the current year. A regular annual pruning is therefore necessary to induce good healthy growth which will provide maximum fruit bearing area on the tree. The best time for pruning the Ber tree is during the hot, dry season when it shed its leaves and goes to rest.

## 7.6 Observations :

The student should take and record the following observations:

| Sl. No. | Fruit crops pruned for initial training | Fruit crops pruned for seasonal/ annual bearing | Level of pruning (Heavy/ moderate/ mild) | Wt. of pruned material (Kg.) | No. of scaffold branches allowed in (Ber/ pomegranate/ phalsa) | Number of shoots (Phalsa/ ber), spurs (pomegranate) allowed at the time of pruning | Level of fresh growth | Yield |
|---|---|---|---|---|---|---|---|---|

setting of fruit and its development mainly depends on C/N ratio in the branches of the trees at certain critical seasons. Plants with adequate nitrogen and high carbohydrate accumulation are found to make moderate growth and produce satisfactory crop. Plants with excess of nitrogen and moderate carbohydrates are found to grow vegetatively at the expense of fruit production.

The accumulation of carbohydrates in the branches may be either due to their manufacture or due to their less rapid utilization. In plants which are weak in their growth, carbohydrates may be made to accumulate by supplying them more nutrients and water.

### 8.2.b. Pruning:

Why pruning is done?

The objective of annual pruning in fig is to promote new vigorous growth for bearing. It also removes the dense growth, if any and encourages distribution of growth and flowering.

What parts are pruned?

In places where bush system is adopted, the shoots are headed back every year to about two buds. It produces new shoots which in turn produce fruits.

In North India, where the trees go dormant in winter, severe annual pruning is done leaving only four buds on previous years' growth.

When to prune?

It is done during January-February for obtaining the crop in July-October. Pruning in October is done to get the fruits during the summer months when they fetch higher prices.

In North India, the trees are pruned during the month of December.

8.3.a Precautions:

-Avoid giving the cut deeper than the thickness of the bark.

-Use the technique at appropriate time for best results.

-The notch should be made just above the bud and in a slanting manner.

-Avoid damaging the bud while notching.

-The knife used for notching should be sharp.

8.3.b

-Prune at the appropriate time for best results.

-Avoid damaging the branches while pruning.

-Use sharp instruments to avoid injury to the plant.

-Paste the cut ends with fungicide to avoid any infection.

8.4 Materials required:

1. Budding/grafting knife
2. Secateur
3. Fungicide
4. Alcohol
5. Water

## 8.5 Procedure:

-Take a sharp pointed budding or grafting knife.

-Make a slanting out just (3-5 mm) above the bud.

Two buds located on the middle portion of the shoot may be notched in each shoot. The buds should be healthy and plump.

- Tag the bud with lable noting the date of notching and sprouting.
- Take a sharp secateur.
- Prune the required part of the shoot cleanly without peeling away the bark.
- Paste the cut ends with fungicide.
- Record fruiting after sprouting.

## 8.6 Observations

The pupil should record the following observations

A) Notching in fig.

| Date of notching | No. of buds notched | No. of buds sprouted | Time taken for initiation of sprouting | Time taken for full sprouting | % success in sprouting |
|---|---|---|---|---|---|
| | | | | | |

(B) Pruning in Fig.

| Date of pruning | Period of initiation of sprouting | Fruit yield | | Remarks |
|---|---|---|---|---|
| | | No. | Weight | |

## 8.7 Expected behavioural outcome

The pupil acquires the following abilities to:

Grade

- understand the principles of pruning and notching;
- reason out as to why, where and when these operations are required to be carried out;
- perform actual notching/pruning and to record the required observations after the operations.

The teacher should evaluate the pupil for the above abilities.

## 8.8 Questions:

1. What are the objectives of notching in fig?

iii. Explain how notching induces sprouting of bud?

iii. How notching differs from ringing?

iv. What are the objectives of pruning in fig?

v. How pruning differs from notching?

vi. What do you mean by judicious pruning?

vii. Why the cut for notch should not be given deeper than the bark?

viii. Select the most appropriate answer:

i) Notching in fig ensures:
   a) Removal of apical dominance
   b) Enhances apical dominance
   c) Helps sprouting of notched bud.

ii) Under North Indian conditions, the best time of pruning is;

| | |
|---|---|
| a) January | c) Ocotber |
| b) December | d) November |

iii) Number of months required from pruning to harvest in fig is:

| | |
|---|---|
| a) 6-8 months | c) 2 months |
| b) 12 months | d) 5 months |

iv) The C/N ratio favourable for fruit bud differentiation should be:
   a. Low nitrogen (N) and highcarbohydrate (CHO)
   b. Low CHO and high nitrogen
   c. High N and high CHO
   d. Low N and low CHO

v) Notching brings about:
   a. Partial interruption of xylem
   b. Partial interruption of phloem

v) Notching brings about:

a. Partial interruption of xylem

b. Partial interruption of phloem

c. Complete interruption of xylem

d. Complete interruption of phloem

---

[illegible] interruption of xylem

[illegible] interruption of phloem

## 9. Activity unit: STUDY OF FLOWERING HABIT IN FRUIT CROPS AND THEIR FLOWER SEX RATIO

### 9.1 Instructional objectives:

The pupil should be able to :

- acquire the knowledge about different types of flowering habit in fruit crops;
- observe the flowering habits;
- acquire the knowledge about the different types of flowers;
- identify different types of flowers;
- determine the sex ratio

### 9.2 Relevant information:

What is a flower bud ?

The bud which produces floral parts only is known as the flower bud, fruit bud or bloss bud. In case the bud produces only floral part it is known floral bud. If it produces a shoot with flowers and leaves, it is known as mixed

How the flower bud is formed ?

In early stages, all buds are vegetative character and initially all these buds are po tial flower buds. That is, if favourable cond tions are provided, any bud can transform and differentiate itself into a flower bud. Howev once it is differentiated, it will not revert a vegetative bud.

## What is the meaning of 'flower bud initiation' and 'flower bud differentiation'?

The physiological and morphological changes that occur in a vegetative bud and its change over to reproductive phase or to become a flower bud may be called as flower bud initiation. The developmental changes that occur in flower bud after its initiation towards formation of the embryonic flower inside the bud, is known as flower bud differentiation.

## What is flowering habit?

The manner or pattern in which a plant produces its flowers is known as its flowering habit or bearing habit or fruiting habit. Bearing habits are specific to kind of plant and it may be either terminal or lateral in pure or mixed form.

## Why the knowledge of flowering habit is necessary?

The knowledge will be of much importance in regulating the bearing of any plant by means of pruning. Terminal bearers are normally not pruned whereas in lateral bearers, pruning certainly increases the bearing by encouraging the lateral buds.

## What is sex ratio and why its knowledge is necessary ?

The ratio between the female or hermaphrodite flowers and male flowers in any plant is referred to as sex ratio. The knowledge of sex ratio gives the idea about the bearing potential of the crop or cultivar. Usually the crop or cultivar which has higher sex ratio (more of female or bisexual flowers than the male) bears a heavy crop than with lower sex ratio. This information will also be useful while selecting the parents in a breeding programmes.

9.3 Precautions:

- Select such plants for observing the bearing habit where fairly a large number of shoots have flowers
- Select the well developed flowers inflorescence where majority of the flowers have opened for observing the sex ratio.
- Ensure that the floral parts are not damaged while collecting the flowers or inflorescence.

9.4 Materials required :

1. Forceps
2. Watch glasses
3. Petridish
4. Teasing needle
5. Hand lens

9.5 Procedure:

- Observe the position of flower/inflorescence on the shoot to decide the flowering habit
- Take out individual flowers with the help of forceps.

- Observe the sex of each flower with the help of a hand lens.
- Take the count of flowers based on their sex.
- Calculate the sex ratio from the recorded data.

## 9.6 Observations:

The pupil should record the following observations in the given tables.

a. Bearing habit

| Sl. No. | Fruit crop | Bearing habit | Remarks |
|---|---|---|---|
| 1. | Mango | | |
| 2. | Orange | | |
| 3. | Guava | | |
| 4. | | | |
| 5. | | | |

b. Flower sex ratio

| Sl. No. | Fruit crop | Flowers | | | Sex ratio |
|---|---|---|---|---|---|
| | | Male | Female | Hermaphrodite | |

## 9.7 Calculations:

The pupil should calculate the sex ratio and ascertain the flowering habit based on the observations recorded in the above tables.

## 9.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

- know the different types of flowering habit in plants and its importance ;

- observe different types of flowering habit ;
- identify different types of flowers;
- calculate the sex ratio.

The teacher should evaluate the pupil for the above abilities.

## 9.9 Questions:

1. What is a flower bud?

2. How the flower bud is formed?

3. What is flower bud initiation?

4. What is flower-bud differentiation?

5. Why the knowledge of flowering habit is necessary to a horticulturist?

6. What do you understand by flowering habit?

7. What is sex ratio? How is it calculated?

8. State whether the following statements are True or False:

i. All buds are potential flower buds T/F

ii. A flower bud can revert to a vegetative bud T/F

iii. Vegetative bud can be converted into flower bud T/F

iv. Terminal shoots of mango should be pruned to promote flowering T/F

v. High sex ratio results in better fruit set T/F

vi. Flowering habit is different from fruiting habit. T/F

## 10. Activity Unit: STUDY OF POLLINATION IN CUSTARD APPLE AND PERFORMING HAND POLLINATION

### 10.1 Instructional objectives

The pupil should be able to:

- know the type of flower (unisexual or bisexual);
- know the meaning of pollination and types of pollination;
- know the nature of the flower (colour, shape, size, position etc);
- know the time of anthesis, anther dehiscence, stigmatic receptivity or maturation of different sex organs in the flower;
- know whether it is self pollinated or cross pollinated;
- know the extent of self pollination as well as cross pollination in a fruit crop;
- perform hand pollination.

### 10.2 Relevant information

What is pollination?

Pollination is a process in which the pollen are deposited on the stigma.

Importance of pollination

Pollination is necessary for good fruit set and higher yields. Pollen is a source of auxin which helps in fruit set after fertilization.

In some fruit plants, because of bisexuality of flowers and maturity of the sex-organs at the same time, higher fruit set is possible. In some others, owing to unisexuality and maturity of the sex organs at different times pollination and fruit set do not take place resulting in heavy flower drop and hence poor yields.

In custard apple, a medium sized tree bears about 10 to 1500 flowers in the season but most of them drop and onl about 2 per cent flowers set and bear fruits. The sex orga in the flower mature at different times and this condition referred to as dichogamy, but when stamens mature before th pistil the phenomenon is called Protandry. Unless pollinat takes place within 3 days of anthesis (petal opening), the entire flower, including the aggregate ovaries, drops.

Fruit set and yield can be improved considerably by hand pollination.

## 10.3. Precautions:

- Take note of the season/month of flowering in the year and duration of flowering
- Flower count should be taken after flower bud initi tion in one or two trees that are well exposed to sunlight.
- Take care to tag small labels numbered serially to e flower noting the date of visible initiation.
- Take care to count the number of days taken for fl bud development and opening from the date of taggi

- Take care to record the anthesis each day at hourly intervals.
- Take care to record the time and percentage of anther dehiscence in the opened flowers.
- Take care to record the duration of stigmatic receptivity.
- Take care to bag some known number of flowers for recording the fruit set by self-pollination, if any.
- Take care to hand pollinate some known number of flowers that are emasculated with fresh pollen on different days of anthesis and calculate the fruit set per cent and duration of stigmatic receptivity.
- Take care to have a record of the different insect pollinators that visit the flowers.

10.4. Materials required

1. Paper labels for tagging the flower buds
2. Butter paper bags of suitable size
3. Pocket lens/Table lens
4. Teasing needles
5. Forceps
6. Petri dishes with lids
7. Camel-hair brush
8. Stapler with pins
9. Note book and pencil
10. Foot scale

## 10.5 Procedure

- Visit the orchard and tag a known number of small and uniform flower buds of custard apple for calculating the days (average) required for flower bud development.
- Lable a known number of fully developed flower buds that are to open next day.
- Make a note of the flowers opened at hourly intervals during the day.
- Make a note of the dehiscence of anthers at hourly intervals during the day.
- Cover a known number of fully developed flower buds with butter-paper bags and staple them for finding out fruit set by self pollination.
- Tag a known number of fully developed flower bud for finding out the percentage of fruitset by open pollination.
- Tag a known number of flower buds that are full developed and are to open by next day; emascula and bag them to see the parthenocarpic fruit se if any.
- Tag a known number of flower buds that are to open next day and emasculate and bag them. Har pollinate these emasculated flowers with fresh pollen next day onwards for 3 or 4 days (25 flowers each day) and bag to find out the extent

Table 3: Anther Dehiscence:

| | |
|---|---|
| Date of tagging | |
| No. of flowers tagged | |
| No. of flowers in which Anthers dehisced. | |
| Percentage | |

Table 4 : Receptivity of Stigma (by actual pollination and by visual observations using a Table lens)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of emasculating flowers & bagging | | | | | | | | | | | |
| No. pollinated on each day. | Days before opening | | On the day of opening | Days after opening | | | | | | No. set | Percentage |
| | 2 | 1 | | 1 | 2 | 3 | 4 | 5 | 6 | | |

fruit set as well as the longevity of stigmatic receptivity.

- Tag a known number of flower buds that are well developed and are to open next day; emasculate hand pollinate and bag them to know the extent o: fruit set by cross-pollination (hand pollination

10.6. Observations:

- Record the month/months of flowering and peak flowering season.
- Record the average number of days required for flower bud development from the date of visible initiation to opening.
- Record the average size (length and diameter), colour and other morphological features of flow
- Record the time and percentage of anthesis.
- Record the time and percentage of anther dehiscence.
- Record the stigmatic receptivity and its durati by fruit set percentage.
- Record the colour and shape of the pollen grai under table lens.
- Record the percentage of fruit set in differen kinds of pollination.

Table 1 : Time taken for flower bud development in custard apple.

| Sl. No. | Date of opening. | Date of tagging (Common date) | |
|---|---|---|---|
| | | No. of bud opened | Average No. of days. |

Table 2: Time of Anthesis:

Date of tagging and No. tagged. (in Hours)

| Time of flower opening | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of flowers opened | | | | | | | | | | | | | |
| Percentage | | | | | | | | | | | | | |

Table 5: Kind of pollination and fruit set.

| | Initial No. | No. set | Percent fruit set. | Remarks. |
|---|---|---|---|---|
| 1. Flower buds merely tagged (No.) | | | | |
| 2. Flower buds bagged (No.) | | | | |
| 3. Flower buds emasculated & kept open. (No.) | | | | |
| 4. Flower buds emasculated and bagged. (No.) | | | | |
| 5. Flower buds emasculated, hand pollinated and bagged. (No.) | | | | |

10.7. Expected behavioural outcome:

The pupil acquires the following abilities to:

| | Grade |
|---|---|
| - understand the meaning of pollination; | |
| - understand the meaning of self and cross-pollination; | |
| - understand the problems in self-pollination and the expected results; | |
| - understand the importance of hand pollination; | |

- pollinate emasculated flowers by hand.

The teacher should evaluate the pupil for the above abilities.

Grade

10.8. Questions:

1. What is pollination?

2. What are the different types of pollination?

3. Name the different agents involved in pollination?

4. What are the functions of pollination?

5. What are parthenocarpic fruits?

6. Even though a large number of flowers are borne in custard apple, yet, at harvest, only a few fruits are seen. What reasons would you assign

for poor bearing?

7. What are your suggestions for increasing fruit set in custard apple?

8. What is dichogamy? Is it an internal fruit set in custard apple?

9. What is protandry? Name a fruit plant in which it is observed.

10. What happens when dry pollens are deposited on receptive stigma or fresh and viable pollen on a non-receptive stigma in custard apple?

11. Choose the best answer:

    i) Pollination can be defined as:
        (a) Transfer of pollen to stigma
        (b) Transfer of stigma to pollen
        (c) Transfer of ovules
        (d) Transfer of embryo

    ii) Pollination aids better fruit set. The reason is:
        (a) It provides auxins for growth.
        (b) It ensures fertilization and growth of embryo.
        (c) Both the above.
        (d) None.

    iii) Better fruit set can be ensured in plants where the male and female parts of the flower mature :
        (a) at the same time
        (b) Male maturing first

(c) Female maturing first

(d) None.

iv) The most important point to be taken into accoun during hand pollination is:

(a) Stigmatic receptivity

(b) Anther deliverance

(c) Both

(d) None.

v) Match the following:

i) Poor fruit set in custard apple is due to:

(a) Protandry

(b) Protogymy

(c) Incompatibility

(d) Abortion of the ovary.

ii) The most important function of pollination is:

(a) To stimulate the ovary to grow

(b) To provide male gamete

(c) Both

(d) None.

## 11. Activity Unit: STUDY OF FRUIT SET AND FRUIT DROP IN MANGO, CITRUS, GRAPES, GUAVA and SAPOTA.

### 11.1 Instructional objectives;

The pupil should be able to;

- know the extent of fruit set (%);
- know the extent of fruits retained till harvest (%);
- know the extent of flower and fruit drop at different stages of development;
- know the relationship between sex ratio and fruit set;
- know the causes for fruit drop;
- know the factors involved in fruit setting.

### 11.2 Relevant information:

Fruit set is the process commencing from the deposition of pollen on the stigma till the union of the gametes. Good fruit set is ensured when there is successful pollination, due to availability of viable pollen, presence of favourable climatic conditions for pollen tube growth, presence of proper nutrition and compatibility between male and female parents. Fruit plants such as mango, citrus, grapes and others bear a large number of flowers but most of them do not set and are carried to maturity.

Flower and fruit drop occurs at different stages of development.

(a) Flower drop occurs when the buds are still small and before opening (may include deformed pistillate flowers).

(b) All the staminate flowers drop away after anthesi and another dehiscence.

(c) Perfect flowers drop after opening.

(d) Natural drop occuring in several ways like the first drop of flowers occurring shortly after opening and usually, flowers with aborted pistils drop.

(e) The second drop occurs after 15 days of fruit se Unfertilized flowers and fruits drop off at this stage. Some fertilized flowers also drop off du to adverse climatic conditions and poor nutritio

(f) The third drop occurs in young fruits at jowar grain size, pea size or marble size due to formation of abscission layers in the young frui stalks. This drop removes some developing frui at the time of seed development.

(g) Pre-harvest fruit drop occurring a few weeks before harvest causes a greater los to the growers.

(h) Causes for poor fruit set:

Several causes may be attributed for poor frui set in fruit crops. They may be:

1) Presence of adverse climatic conditions such as heavy rain, hailstorms, high temperature and low humidity or low temperatures.
2) Physiological factors such as fluctuations in water content, lack of nitrogen or other nutrients, weak condition of the shoots, seedlessness and immaturity of the shoots.
3) Cultural operations such as pruning at fruit development stage, excessive irrigation and bad aeration in soils.
4) Incidence of insect pests - hoppers (Mango), fruit fly, diseases such as anthracnose and powdery mildew in grapes and mango.
5) Unisexuality of flowers, presence of more number of "male flowers as compared to perfect or female flowers."

Perfect flowers in some mango cultivars are as follows:

| | |
|---|---|
| Jehangir | 1.25% |
| Alphonso | 6 - 11% |
| Bangalora | 10% |
| Dasheri | 30% |
| Langra | 70% |

In each panicle there will be about 800 to 9000 flowers but only about 0.1% flowers set and are carried to maturity since most of them are staminate In the perfect flowers also only one functional stamen is present.

6) Heterostyly and dichogamy conditions in the flowers restricting availability of pollen.

Eg. Sapota - Heterostyly

Avocado & custard apple } Dichogamy
Sweet lime, tangelo }

7) Insufficient quantities of pollen
Eg. Grapevine.

8) Self sterility : Eg. Grape vine varieties such as Pandhari Sahebi and Brighton are self unfruitful. They have reflexed stamens bearing sterile pollen. Cross pollination is necessary with interplanted self fruitful varieties such as Bhokri.

9) Poor ovule development, aborted embryo, etc. Such flowers will drop in the bud stage before opening or just after opening of the buds. Mango, citrus, grapes, guava and sapota are highly cross-pollinated crops.

## 11.3 Precautions:

- Take care not to pull or bend the branches forcibly.
- Take care to label the buds for recording the percentage drop.

- In crops like mango and grapes, the flowers are tiny and delicate. Hence, handle carefully.
- Take care to record the flowers and fruits dropped every day, category-wise based on the development.
- Collect the abscised flowers and fruits carefully in the butter paper bags for examination in the laboratory.
- Draw their diagrams and indicate size and shape.
- Take care not to disturb the insect pollinators.

## 11.4 Materials required:

1) Flowering panicles or twigs.
2) Butter paper bags for collecting the abscised flowers and fruits.
3) Forceps
4) Dissecting needles
5) Table lens
6) Tags for labelling
7) Record book and pencil.

## 11.5 Procedure:

- Record the season of flowering.
- Record the weather conditions like light, wind velocity etc during the period of observation.

- Record the number of panicles in the tree/branch, and number of flowers in 10 panicles (select a few important commercial varieties)
- Observe the condition of the abscised flower buds, flowers and fruits of different stages of development.
- Tag sufficiently a large number of tiny flower buds in all directions and along the height of the tree for noting the sex ratio.
- Observe and record the soil condition such as dry/wet.
- Note and record whether there is only one or more varieties planted in the orchard.
- Have a record of the extent of flower and fruit drop on each day from the date of tagging till the end of the season.

11.6 Observations:

The pupil should take and record the follow observation

- Count the number of flowers and fruits dehisced every day.
- Count the total number of flower buds or flowers in 5-10 inflorescendes and calculate the per cent set.
- Note and record all the varieties existing in the orchard and how they have been planted (interplanted or in separate blocks).

## 11.7 Expected behaviour outcome:

The pupil acquires the following abilities to:

| | Grade |
|---|---|
| - understood the importance of studying the flower and fruit drop in fruit crops; | |
| - understood the causes of flower and fruit drop; | |
| - distinguish between intact and abscised flowers and fruits; | |
| - distinguish between the fruits of normal drop and pre-harvest drop; | |
| - suggest methods for preventing such drops. | |

The teacher should evaluate the pupil for the above abilities.

## 11.8 Questions:

1. What are normal and pre-harvest fruit drips?

2. What reasons you would attribute for very poor fruit yield in certain varieties of mango even though the tree flowers profusely?

3. Which are the internal factors responsible for unsatisfactory fruit set in fruit crops?

4. Explain the terms with examples:

   a) Heterostyly

   b) Self unfruitful condition

   c) Herkogamy

   d) Cross-pollinated crop.

5. A heavy fruit drop occurs in seedless varieties of fruits such as guava, grapes and lime. What may be the reasons?

6. Match the following pairs:

   i. Self-sterile grape variety

   ii. Mango variety with lowest sex ratio

   iii. Self incompatible fruit crop

   iv. Serious insect pest in mango causing flower/fruit drop.

   (A) Sapota (Kalipatti Cv.)

   (B) Happers

   (C) Jahangir

   (D) Pandhri sahebi

   (E) Dusheri.

7. Select and tick the most appropriate answers.

   1. Fruit drop at the 'marble' size stage is due to:
      - (a) Heavy rain
      - (b) Formation of abscission layer

   2. Heavy rainfall during flowering causes:
      - (a) Poor pollination
      - (b) Does not affect pollination
      - (c) Improves pollination

   3. Lack of viable pollen results in
      - (a) Poor fruit set
      - (b) No fruit set

   4. Pollen viability is affected most by:
      - (a) Humidity in atmosphere
      - (b) Temperature
      - (c) Light

   5. Low fruit set in Sapota is due to:
      - (a) Self incompatibility
      - (b) Lack of pollination
      - (c) Low sex ratio

   6. Highest percentage of bisexual flowers in mango variety:
      - (a) Alphomo
      - (b) Dasheri
      - (c) Langra
      - (d) Jehangir

## 12. Activity Unit: INTERCULTURAL OPERATIONS IN FRUIT CROPS

### 12.1 Instruction objectives:

The pupil should be able to:

- know the different intercultural operations to be carried out in fruit crops;
- know the merits and demerits of intercultural operations;
- know the proper time to carry out different intercultural operations;
- know the principles underlying and the importance of various intercultural operations;
- conduct intercultural operations in fruit crops.

### 12.2 Relevant information

Hoeing, weeding, sod culture, mulching, inter-croppin and green manuring are some of the important intercultural operations to be attended to while managing and orchard.

i) Hoeing and weeding

Orchard soils are cultivated to remove weeds and t facilitate subsequent operations such as irrigatio and manuring. Deep tillage should be avoided in orchards. A few shallow cultivation operations should therefore be the feature of the orchard management. Tillage need not be practiced all ove in the young orchards. It will be sufficient if i is restricted to the area covered by the roots, th the rest of the splace being reserved for inter-green manure crop. Periodic shallow hoeing helps to check weed grwoth.

ii) Sod culture: It is a system of soil management wherein the plants are grown in permanent grass without tillage and addition of any litter. It is suitable for orchards in undulating lands or on hill slopes. It reduces soil erosion.

iii) Mulching: It is a system in which materials such as hay, straw, cut grass or dry leaves are placed on the soil or near the plant base to conserve soil moisture. The mulches also control weeds.

iv) Inter-crops, cover crops and green manuring

Any crop that is raised in the alleys of an orchard is strictly an inter-crop. Crops raised specially for enriching the organic matte of the orchard soil are generally known as green manure crops. Crops sown to protect the soil with a vegetative cover are termed as cover crops.

## 12.3 Precautions:

- Follow sod culture in areas where tillage operations are impracticable.
- Sod culture should not be followed in soil poor in nutrients(N) and where scarcity of water persists.

- Raise green manure crops during rainy season.
- Choose the right type of mulch material, intercrop, cover crop and green manure crop considering the stage of growth of the main crop.
- Avoid deep tillage to minimise damage to the roots.
- Ploughing or digging operations should be carried out when the trees are least active.
- The cover crop/intercrop selected should not compete with the main crop for nutrients or moisture.
- Use the animal or power drawn implements carefully.
- Check the weeds by manual operations like light hoeing, digging or by use of recommend weedicides. Take necessary care while apply weedicides.

12.4 Materials required:

For mulching - Straw, dry leaves, dry plant residues plastic mulches(black) etc.

Intercrops - i) Seeds of leguminous crops like cowpea, dolichos lablab, horse gram and bengal gram.

ii) Planting materials of filler crops like papaya, banana, and pineapple or seeds of seasonal vegetable crops.

iii) Planting materials of short duration annual crops like ginger, termeric.

Cover crops - Calapagonium muconoides and fodder cowpea.

Green manure crops-Sunhemp, cowpea, Dhaincha and others.

12.5 Procedure:

- Hand weed using "Varvari" or small "Kudali".
- Spray Diuron at 3 kg/ha (1 kg Diuron in 400 liters of water) when the banana plants are 1-2 months old and before the weeds emerge control the weeds.
- Identify the weed population(monocots and dicot weeds) for choosing the right kind fo weedicide.
- Mulch with straw (paddy/wheat) to conserve moisture.
- Stop irrigation at least one week prior to harvesting.
- Clean the channels and earth up wherever necessary.
- In widely spaced fruit crops, like mango, sapota etc. grow inter crops.
- In widely spaced fruit crops, choose the right type of inter crop and cover crop depending on the season.

- Apply mulch at the beginning of the dry season. If necessary, periodically replace the mulch or incorporate the mulch into the soil.

12.6 Observations:

The pupil should take and record the following observations:

- Common weeds noticed in the orchard
- Weedicides sprayed, the number, concentration and period of spray.
- Number of hand weedings and time of operation.
- Number of hoeing and time of hoeing.
- Mulching materials used and the time of mulching.
- Type of cover crop raised, date of sowing/harvest/incorporation into the soil.
- Type of inter crop raised, date of sowing, time of harvest and yield.
- Yield harvest from the main crop.

12.7 Calculations:

i) Calculate the cost of each operation including the inputs and labour.

ii) Work out the economic yield and biological yield of crops considered including intercrops.

iii) Work out harvest index of some important fruit crops.

**Note:**

Bio-logical yield += Total biomass produced by the plant.

Economic yield = The economically important part of the plant. Ex. fruits, grains, etc.

Harvest index (HI) = $\frac{\text{Economic Yield (EY)}}{\text{Biological yield (BY)}} \times 100$

OR

$$HI = \frac{EO}{EY} \times 100$$

## 12.8 Expected behavioural outcome

The pupil acquires the following abilities to:

- know the inter cultural operations in an intensively cultivated crop and less intensively cultivated fruit crop;
- know the importance of hoeing, mulching, growing of cover and intercrops;
- practice intercultural operations in fruit crops.

| Grade |
|---|
| |

The teacher should evaluate the pupil for the above abilities.

## 12.9 Questions:

1. What are the advantages of leguminous crops?

2. Name the leguminous crops that can be grown as inter-crops, cover crops, and green manure crops.

3. List out the important mulch materials available (plant residues) for use as mulching material in orchards.

4. Under what circumstances would you take up sod culture in an orchard?

5. List the names of weeds that appear in citrus/banana/grape orchards.

6. Why hoeing is done? How this operation is done in an orchard? Discuss this aspect with reference to closely spaced plants and widely spaced plants.

7. Why kerosene oil is used while desuckering banana?

8. State whether the following statements are True or False. Round off the correct answer.

   i. Leguminous cover crops fix atmosphere nitrogen T/F

   ii. Saw dust is considered as the best mulch material. T/F

   iii. The main purpose of mulching is to conserve soil moisture T/F

   iv. Mulches also help in controlling weeds. T/F

   v. Deep tillage should be practiced in an orchard as it can effectively control weeds. T/F

   vi. Sod culture is more useful in level orchards than in sloping land. T/F

## 13. Activity Unit: MANURING OF DIFFERENT FRUIT CROPS WITH FARM YARD MANURE AND CHEMICAL FERTILIZERS.

### 13.1 Instructional objectives:

The pupil should be able to:

- know the nutrient composition of FYM and chemical fertilizers;
- know the forms of organic manures;
- know how FYM improves plant growth;
- know the types of chemical fertilizers;
- apply the FYM and chemical fertilizers to fruit crops in proper quantities.

### 13.2 Relevant information:

What are the nutritional requirements of plants?

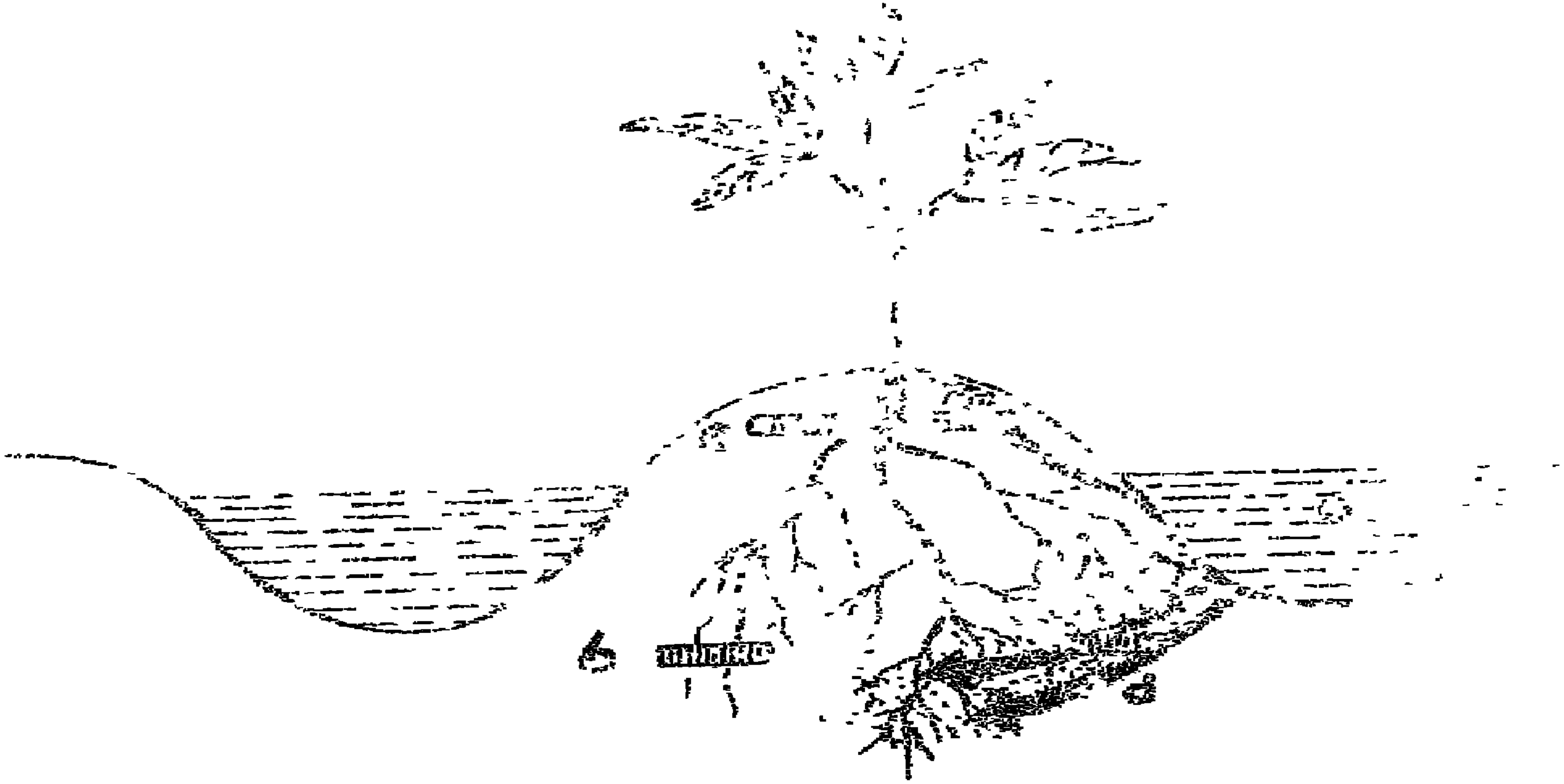
A plant requires for its growth 13 elements such as N, P, K, Ca, Mg, S, Mn, Bo, Cu, Fe, Zn, Mo and Cl. The manuring of an orchard is done to supplement the elements what are already available to the plants. The quatity of fertilizer and manures to be supplied to a tree is governed by requirement of the plant in terms of nutrient removal and other factors relating to soil and climatic conditions, and efficiency of fertilizers used.

What are the various manures and fertilizers?

Orchards are manured both with organic manures and inorganic fertilizers. Organic manures such as green leaf, farm yard manure and oil cakes improve the physical condition of the soil such as structure and also add certain nutrients to the soil. Among the chemical fertilizers, urea is the most common nitrogenous fertilizer used. Sulphate of ammonia, ammonium phosphate and calcium ammonium nitrate are other important sources of nitrogen. Super phosphate, rock phosphate, double super phosphate, calcium phosphate, bone meal, and ammonium phosphate are the common sources of phosphorus. Potasic fertilizers, generally recommended are muriate of potash (sulphate of potash) and potassium chloride.

What are the methods of their application?

The method of application depends on the root distribution, soil and climatic conditions, spacing between the trees and cultural practices adopted. In young trees, the fertilizers are generally spread, first in the area covered by the roots or a little beyond. In the older orchards, the fertilizers are applied all over the orchard or upto 1.0 to 1.5 m beyond the dripline of the trees. The fertilizers should be forked into the soil or ploughed under, followed by light irrigations. Organic manures should be evenly spread all over the orchard and ploughed under.



PLACEMENT OF FERTILIZER UNDER IRRIGATION

a - improper placement
b - proper placement

c - water
d - water movement

Note: The teacher/pupil is advised to refer to relevant information furnished at 14.2

## 13.3 Precautions:

- Use well rotten farm yard manure.
- Apply only the recommended doses of farm yard manure or chemical fertilizers to avoid wastage and possible toxic effects.
- Apply the nutrients at the right stage(s) of growth of the plant for maximum utilization by the plants.
- Follow proper placement of fertilizers.
- Irrigate profusely following the application of fertilizers.
- Choose the right sources of N, P and K.

## 13.4 Materials required:

i. FYM and chemical fertilizers or fertilizer mixtures.
ii. Tractor/cart/wheel barrow.
iii. Containers - baskets, bags etc.
iv. Implements - spade, pick axe, forks etc.
v. Physical balance.

## 13.5 Procedure:

- Keep ready the materials required for fertilizer application.
- Calculate how much to apply per tree/plant based on N, P and K to be added to each tree.

- Apply the FYM well in advance and incorporate into the soil or apply along with the chemical fertilizers.
- Follow surface application/fullor/ring/band application method depending on the kind and age of fruit plant and layout of orchard.

## 13.6 Observations

The pupil should be able to record the following observations:

| Fruit crop for the study | No. of trees applied with N, P, K, mixture & FYM | Type of ferti-lizers and dose per tree | Initial growth para-meters of the tree | Growth parameters* recorded at regular intervals(months) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 |

---

* These may include new growth, flowering, height and spread of tree and general appearance of the tree.

## 13.7 Calculations:

- Calculate the quantity of fertilizers required to prepare a fertilizer mixture containing 100 kg N, 50 kg $P_2 O_5$ and 150 kg $K_2O$.
- Calculate the labour cost.
- Calculate the total cost of applying manures and fertilizers/ha.

## 13.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | GRADES |
|---|---|
| - identify different kinds of fertilizers; | |
| - know the proper placement of fertilizers; | |
| - learn the techniques of preparation of fertilizer mixtures and their storage; | |
| - prepare ground for the application of manures and fertilizers; | |
| - know the effects of fertilizer application. | |

The teacher should evaluate the pupil for the above abilities.

## 13.9 Questions:

i. How organic manures help to improve the physical properties of the soil?

ii. Why should irrigation be given immediately after fertilizer application?

iii. What are the important sources of organic manures?

iv. What is green manuring?

v. What happens if excess of nutrients are supplied to the plants?

vi. Why split application of nutrients is recommended to fruit plants?

vii. Why fertilizers should be applied at appropriate stage of the crop?

viii. What are the fertilizer recommendations for the following crops?

(a) banana (b) papaya (c) citrus

ix. State whether the following are TRUE or FALSE:

a) Organic manures are useful in improving soil physical characters only. T/F

b) Inorganic manures are obtained from plant and/or animal sources. T/F

c) By using Ammonium sulphate, plants can get both nitrogen and sulphur. T/F

d) It is advisible to follow the fertilizer application by a light irrigation. T/F

c) Farm yard manures need not be applied if sufficient fertilizers are available. T/F

f) Application of fertilizers in the rainy season helps better uptake by the plants owing to good soil moisture status. T/F

g) Among all nitrogenous fertilizers, urea contains the highest amount of nitrogen. T/F

h) A very heavy rainfall soon after fertilizer application leaches the fertilizer away from the root zone. T/F

## 14. Activity Unit: FOLIAR APPLICATION OF NUTRIENTS IN FRUIT TREES.

### 14.1 Instructional objectives:

The pupil should be able to:

- know the nutrients required by the plants;
- know the advantages and disadvantages of foliar application of nutrients;
- know the situations when foliar application of nutrients is required to be given;
- know the nutrient elements, their dose and time of application;
- undertake foliar application of nutrients.

### 14.2 Relevant information:

What are nutrient elements?

Sixteen elements are known to be essential for the gorwth of most of the plants. The essential elements are: Carbon (C), Hydrogen (H), Oxygen(O), Nitrogen(N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur (S), Iron (Fe), Manganese(Mn), Molybdenum (Mo), Copper (Cu), Boron (B), Zinc (Zn) and Chlorine (Cl).

Mineral nutrients are divided into two groups according to the quantity the plants use. The primary macro nutrients that are used in large amounts are nitrogen, phosphorus and potassium, the secondary mineral nutrients that are used in lesser amounts than the primary-nutrients are:

magnesium and sulfur; and the remaining ones utilized in minute amounts are the micronutrients. Carbon, hydrogen, and oxygen are not mineral nutrients but they are essential elements. Some of these macro and micro nutrient elements are supplied to plant through foliar sprays, whenever necessary.

When to give foliar sprays and what nutrients to give?

a) When there is difficulty for absorption through the soil (magnesium and trace elements).

b) When the nutrients are required in very small quantities (trace elements);

c) On crops which are sprayed at regular intervals with plant protection materials (Coffee, banana, citrus, pineapple, tea, grapevine etc.). The nutrient elements are mixed with spray mixtures, conveniently.

d) When certain deficiencies in plants are to be corrected immediately.

e) Where uniform soil application of nutrients is difficult due to undulating topography of the soil.

f) Usually nitrogen in the form of urea (free of biuret) and all the trace elements are given, Under certain situations, phosphorus, potash and magnesium are also given as foliar sprays.

g) Foliar sprays should be given to the plants during the bright sunshine hours, for efficient absorption.

### 14.3 Precautions:

- Follow the correct dosage to avoid leaf scorch.
- Note that the foliar sprays would only be excellent supplement to soil application, but they cannot be substitute for soil application.
- Use high volume sprayers when the concentration of the solution is lower and use low volume sprayer when the concentration is higher.
- When mixed with the plant protection sprays, their compatibility has to be ascertained.
- Foliar application of macro nutrients or trace element elements should be supplied at intervals. Major portions of the macro nutrients should be supplied at intervals. Major portions of the macro nutrients should be supplied through the soil.
- Foliar application may have to be repeated if there is a rain immediately following the spray.

## 14.4 Materials required

- i. Sprayers - low volume and high volume.
- ii. Containers (wooden/copper)
- iii. Wetting agent
- iv. Macro nutrients and trace elements
- v. Insecticides or fungicides
- vi. Hydrated lime.

## 14.5 Procedure

- Note down the type and intensity of deficiency of elements before spraying.
- Prepare the spray solution of proper concentration of the required nutrient element (The concentration may vary from 0.5 to 2.0 per cent depending on the element/type of tree/stage of growth). Usually nitrogen is given in the form of urea at 1-2 per cent. If spray of more than one element is required to be given, it could be a combined spray subject to the compatibility of the elements used.
- Spray the solution to complete drenching of the foliage.
- Add wetting agent while preparing the solution at the rate of 1 ml/litre.
- If low volume sprayer is used, 5 kg urea in 35 litres of water or along with the plant protection solutions could be used.

- Micro nutrients like
  could be sprayed at 0
- Note down the trees s
  effect of foliar spra
  cies in nutrient elem

## 14.6 Observations

The pupil should be abl
observations:

| Sl. No. | Type of deficiencies noted on the tree before spraying | Spray of elements given, with their concentration | No tr sp ed |
|---|---|---|---|

## 14.7 Calculations

1. Calculate the amont of the nutrient element required to spray one ha. of banana garden. The strength of the solution is 2% and the total quantity of spray solution that may be used is 1250 litres (Urea N = 44%).

ii. Calculate the amount of lime required to prepare 1000 litres of 1 per cent Bordeaux mixture.

iii. Labour force required for spraying.

iv. Total cost of the chemicals and labour cost.

v. Total cost of spraying /ha.

14.8 Behaviou

## 14.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | GRADE |
|---|---|
| - understand the deficiency symptoms; | |
| - know the type of sprayers (high/low volume)Rs; | |
| - learn the procedure of preparation of solutions and spraying; | |
| - actually practice or conduct the spraying operations; | |
| - understand the response of the plants to such sprays. | |

The teacher should evaluate the pupil for the above abilities.

## 14.9 Questions:

i. What are the advantages of foliar application of nutrients?

ii. What are the fruit crops that generally receive certain nutrients through foliar sprays?

iii. What are the source of nutrients for N and K for foliar application?

iv. What is the role of a wetting agent used in foliar sprays?

v. Why should the strength of the solutions be different for high volume sprayers and low volume sprayers?

vi. What precautions that one should take in adopting foliar sprays?

vii. What is compatibility of elements for mixing in a combination spray?

viii. State if the following statements are TRUE or FALSE. Reasons of the correct answer.

a) Foliar sprays should be taken up during cloudy weather for ensuring better uptake. T/F.

b) All the sixteen nutrients required for plant growth are supplied through soil. T/F.

c) Ca, Mg and S are included under macro elements. T/F

d) Higher bi-uret content in urea makes it unsuitable for foliar application. T/F

e) Foliar application of nutrients is better than soil application as there will not be fixation of nutrients. T/F

f) Foliar feeding of plants with nutrients during rainy days is simply wasteful. T/F

g) A one per cent urea spray can supply 80 per cent urea to the plant. T/F

h) Wetting agents help in.proper spread of the spray on the leaf. T/F

## 15. Activity Unit:

### SELECTION AND CARE OF TWO DIFFERENT FRUIT CROPS FROM FLOWERING TILL HARVEST

## 15.1 Instructional objectives:

The pupil should be able to:

- ascertain various cultural needs after flowering till harvest;
- understand the problems in flowering, fruit set and fruit development;
- understand and provide the needs of the developing fruit for proper growth and maturity till harvest.

## 15.2 Relevant information:

Fruit plants are of various types. They may be trees such as mango, shrubs such as pomegranate or vines such as grapes. The bearing habit of fruit trees also varies Some may be terminal bearers while others lateral. This should be borne in mind while selecting the fruit crop for the study under this activity unit and it should be better if the two crops chosen belong to the two different groups.

Fruit crops differ in their cultural requirements, fertilizer and water needs. The amount, stage and time of their supply also would differ in different crops. It is necessary that one should be familiar with their needs as recommended to be able to take effective corrective measures whenever necessary.

## 15.3 Precautions:

- Check the availability of plants you are interested in.
- If not available, locate a nearby orchard where they may be available for the present activity.
- Take care to understand the critical needs of growing fruits in all respects and keep the requirements in readiness to provide for better yields.
- Plan and make necessary arrangements to procure the materials required well in time.

## 15.4 Materials required:

i) Labels for marking the selected tree for study.
ii) Note book/record book/pencil
iii) Necessary fertilizers
iv) Plant protection chemicals and equipments
v) Plant growth regulators (if required)
vi) Secateur
vii) Baskets/card board boxes to collect the harvested fruits.

## 15.5 Procedure:

- Select two fruit trees, one as tree fruit (mango) and the other as shrub (Pomegranate/guava). (The Selection of fruit crops for this study may also be based on the bearing habit. One crop could be a terminal bearer such as mango and the other crop with the lateral bearing habits such as grapes. The

The plants selected should have a just started flowering.)

- Label the selected plants with the following information:

Name of the cruit crop:

Variety:

Approximate date of flowering:

Name of the student:
(Roll No. or I.D.No. of the student)

- Read and understand the recommended cultural practices(as given in the theory classes or in any standard text books) to be followed for the two crops selected for the study.
- Supply the required water and fertilizers as per the recommended practices.
- Train or prune the crop as indicated in the recommended cultural practices.
- Take steps to control the pests and diseases, if any.
- When the fruit is mature or ripe, harvest appropriately.

15.6 Observations:

The pupil should take and record the following observations:

For reach of the two-fruit plants selected, observe an record the following:

| Particulars | Crop-1 | Crop-2 |
|---|---|---|
| Date of flowering. | | |
| Date(s) of irrigation | | |
| Date(s) of fertilizer application | | |
| Type of fertilizers applied | | |
| Quantity of fertilizers applied. | | |
| Flowering habit: (terminal/lateral flower borne in current/past seasons growth) | | |
| Intensity of flowering (poor/moderate high) | | |
| Flower type | | |
| Date of fruit set | | |
| Approximate percentage of fruit set | | |
| Time taken from flowering to fruit-set | | |
| Time takem from fruit set to harvest | | |
| Insect/pest observed on the plant(Names) | | |
| Diseases observed (Names) | | |
| Damages caused by pests and diseases, if any | | |

| Particulars | Crop-1 | Crop-2 |
|---|---|---|
| No. of plant protection sprays given. | | |
| Names of chemicals used and concentration | | |
| Yield per plant | | |
| Quality of fruit | | |

## 15.7 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | Grade |
|---|---|
| - perform various cultural operations;<br>- understand the needs of the fruit trees from flowering to harvest;<br>- know the pattern of fruit development;<br>- acquires the knowledge about management of the trees during this period. | |

The teacher should evaluate the pupil for the above abilities.

## 15.9 Questions:

1. Compare the flowering habit of mango and grapevine.

2. The inflorescence of mango is botanically
a______________ and that of grapevine a _____________
(fill the blanks with appropriate owords)

3. Compare critically the composition of inflorescences of mango and grapevine

4. Botanically mango fruit is a __________________
while grape is a _________________
(fill the blanks appropriately)

5. Mango fruit is _____________________
Grape berry is _________________
(State whether they are climacteric or non-climacteric)

## 16. Activity Unit: STUDY OF MORPHOLOGICAL CHARACTERS OF AVAILABLE VARIETIES OF FRUIT CROPS.

### 16.1 Instructional objectives:

The pupil should be able to:

- identify different fruit crops;
- recognise the differences in the morphological characters of leaf, flower and fruit in different fruit crops;
- identify different varieties within a fruit crop based on their morphological characters;
- record the morphological differences.

### 16.2 Relevant information:

What is a variety?

When one or more of the populations of the plant making up a species are sufficiently different morphologically in appearance from the remaining members of the species, they are given a varietal status. When a variety is intentionally in cultivation, it is referred to as a cultivar and abbreviated as cv.

Why to study morphological characters?

Without an accurate understanding of the varietal habits and morphological characteristics or without a proper varietal classification, the selection of a superior variety is not possible. In the programme of crop improvement, before a variety passes from the hands of the breeder to others, its accurate description and comparison with other existing commercial varieties has to be made. It is of importance to the growers to have an idea of the morphological features of a plant to identify varieties true to type. For the extension workers as well as to those engaged in fruit research, such a knowledge is indispensable. The users of fruit are becoming more and more quality conscious and thus variety-conscious. For efficient marketing as well as for the utilization of the fruit in product factories, varietal identification is also imperative.

Terminology used in the morphological studies:

In each variety the morphological characters may be recorded as:

a) Vegetative characters

b) Floral characters

c) Fruit characters

a) Vegetative characters:

Height, shape, form or outline are the prominent features in the descriptions of a tree or a plant. The plant height is generally expressed as tall, medium and dwarf. The tree may be oval with the tree spread very much smaller than the height, round with a height and spread almost equal, or dome shaped with the spread more marked than the height.

The orientation of the leaf is prominently marked in some varieties of fruit crops, and are designated as upheld or erect. On the otherhand, the leaves are termed as droppingor downheld. The leaves on the intermediate position are termed as spreading or out held.

The leaf shape is a distinct varietal character in fruit crops and furnishes simplest diagnostic characters for use by practical growers and nurserymen. The leaves may be elleptic lanceolate, oval lanceolate, ovate lanceolate or of some other shape. Nature of the leaf may be different from variety to variety. Wrinkled leaves form the characteristic feature of some varieties, while twisting of the leaves is prominently observed in others. Wavy margin or curving of the leaf margin backwards slightly or curving upwards in varying degrees, folding etc. are also common and they serve the purpose of distinguishing one from the other. The differences in leaf tip also is yet another morphological feature.

## 16.3 Materials required:

i. Measuring tape
ii. Foot rule
iii. Hand lens
iv. Drawing sheet and pencil
v. Teasing needle
vi. Forceps
vii. Colour chart.

## 16.4 Procedure:

- Visit the orchard and select the major fruit crops for your study.
- Record the height and form of the trees or plants in each of the selected crop and variety within each crop.
- Collect shoots, leaves, flowers/inflorescence and fruits from each variety and label them indicating the name of the crop and variety.
- Transport them to the laboratory for further morphological study and description.
- Record the vegetative, floral and fruit characters of each related variety in a proforma given under the item "Observations" 16.5

## 16.5 Observations:

The pupil should record the observations in the followin format for important varieties of the major fruit crops of the locality.

### A. General:

Common name:

Botanical name:

Variety:

Seedling/grafted/layered:

Rootstock:

Age:

Parentage (if hybrid):

### B. Vegetative characters:

Habit:

Tree, shrub, bush:

Drooping, struggling or
upright:

Plant height:
(Tall, medium dwarf.
If possible, measure
the height)

Plant form:
(oval, round, done)

Crown:
(Shape, compact, openness)

Trunk:
Diameter

Length

Bark:

Surface:

Colour:

Branches:

Thickness:

Number:

Young shoots.

Colour:

Hairiness:
(Sparingly or densely pubescent)

Size:

Spines:

Intensity:

Size:

Cour:

Straight or curved:

Leaf orientation:
(erect, spreading, drooping)

Leaf type
(simple,compound)

Leaf petiole:

Length:

Breadth:

Wing:

Present or absent:

Shape, size and margin:

Leaf blade:

Surface:
(Glabrous, rough, glutinous,
glaucous, spiny, hairy)

Shape:
(Lanceolate, oblong, elliptic,
oval, ovate, cordate)

Margin:
(entire, serrated, wavy, undulated,
crenate, bicrenate)

Apex:
(acuminate, acute, obtuse, refuse,
emarginate, mucronate)

Venation:
(Reticulate, parallel)

Colour (old leaf):
(Leaf-green, glossy, dark green,
pale light, yellowish)

Colour (new):
(light green, reddish, coppery)

Oil glands on the leaves:

Density:

Shape:
(round or oval)

Size:

C

C. Flower characters:

1. Time of blooming:
('Ambe', 'mrig' and 'hastha' bahar)

2. Duration of bloom:

3. Frequency of bloom:
(Single, multiple, ever blooming)

4. Type of flowers:
(hermaphrodite, staminate, pistillate)

5. Colour of flower buds:
(coloured or colourless)

6. Pedicel length:

7. Calyx:

Number:

Shape:

Colour:

8. Corolla:

Number:

Shape:

Aestivation:

Size:

9. Stamen:

Arrangement:

Shape:

Size:

Number:

Position:
(below or above stigma)

10. Gynoecium:

(a) Stigma:

Shape:

Number:

Diameter:

(b) Style:

Shape:

Colour:

Diameter:

D. Fruit characters:

1. True or flase:

2. Time of maturity:
(early, late and mid-season)

3. Size:

Length:

Breadth:

Diameter:

4. Peel colour at maturity:

Green, light green, light yellow,
orange, deep orange, purple,
uniform, blushed on sides, striped.

5. Kind of fruit:

Dry or fleshy:

Drupe, berry, aggregate, hesperidium,
pome, but or achene.

6. Surface:

(Smooth, very smooth, ribbed,
wrinkled or bumpy)

7. Shape:

(oblate, globose, ellipsiod, obloid,
obcord, obovoid, pyriform, oblique,
oval)

8. Apex:

   (chippled, slightly nippled, acute, obtuse, rounded, truncate, depressed or deeply depressed).

9. Navel:

   Absent or present:

   Open or closed:

10. Rind adherence:

    (slight, medium, strong)

11. Segments:

    (no adherence, slight, strong)

12. Vesicles:

    (small, medium, large, slender, medium lobed)

13. Seeds:

    Number:

    Size:

    Colour of cotyledous:

    Chalaza colour:

    Colour of inner seed coat:

14. Uses of the fruit:

## 16.6 Expected behavioural outcome:

The pupil acquires the following abilities to:

GRADE

- identify different fruit crops of the locality;
- identify the important varieties within each fruit crop;
- describe morphological characters of fruit crops;
- appreciate the importance of morphological characters in identifying a variety.

The teacher should evaluate the pupil for the above abilities.

## 16.7 Questions:

1. What is the significance of tree characters in varietal diagnosis?

2. What is the role of environment in modifying the morphological characters?

3. For morphological description of a variety, specimens from an adult tree are to be selected. Why?

## 17. Activity Unit : EVALUATION OF TASTE OF CULTIVARS OF FRUIT CROPS

### 17.1 Instructional objectives:

The pupil should be able to:

- acquire knowledge about the different types of states taste;
- know about the different factors contributing to taste;
- evaluate the fruit crops and their cultivars depending on the taste of the fruits.

### 17.2 Relevant information:

What is taste?

Taste is basically the sensation which is realised when a fruit is placed in the oral cavity of mouth. It is the sensation which is appreciated by the taste glands on the tongue.

Which are the basic types of taste and how they are measured?

The four basic tastes are: (1) sweet (2) sour (3) salt (4) bitter. All except the last one can be assessed quite easily when they are in the pure forms. For example, sweetness can be measured by a refractometer in terms of degree brix: Sourness can be measured with a pH meter or titration and saltiness by chloride determination. However, bitterness is usually measured in relation to a known concentration of a chemical known to have a bitter taste(such as quinine sulphate).

## What are the otherfactors which contribute to taste?

Flavours and odours also contribute to taste and act as the most distinguishing characters between the cultivars of the same crop. They are experienced and felt, but are the most difficult to describe and define. Flavours and odours are the properties of fruits that we perceived by human beings by inhalation through the nasal or oral cavity.

## What are the types of odours and flavours?

There are many types of odour classification, but none of them are wholly accepted. They are cool, mint, perfume, sweet, floral, etherish, sharp, citral, fruity, sour, spicy, musty, warm, putrid, faecal, rancid, nutty, oily, heavy, greasy, rubbery, burnt, woody, menthol etc.

## How the flavours and odours are estimated?

Following are the two ways:

1. Chemical methods: Volatile chemicals which can lead to the sensation of odour in the nasal cavity can be measured by Vapour - phase chromatography, Infra red, untra-violet spectrophotethetry and mass spectrophotometry.
2. Taste Panel method: This is the most popular and simple method to evaluate the taste of fruits and is called as 'Organoleptic test'. In this case, the sensory descriptions of taste is given by trained testing panels

and consumer panels and if these are used with care, the information provided by such methods can be very accurate and valuable. Apart from fruits, it is also commonly employed in evaluating the taste and quality of various horticultural products like fruit beverages, tea, coffee, perfumes etc.

Why the knowledge of taste of cultivars of fruit crops is necessary?

Nature has bestowed different tastes to different fruit crops and so is the case with the different cultivars in a fruit crop. The knowledge of taste of cultivars in fruit crops will not only help to differentiate the cultivars, but also help to assess the most acceptable ones by the consumers.

### 17.3 Precautions:

- Select only the true representatives of the cultivar.
- Use fruits of the same growth and maturity.
- Avoid over-ripe and under-ripe fruits.
- Keep the fruits away from the chemicals which may add their own odour.
- Clean your mouth after every sample.
- For organoleptic test, have a panel of at least 4-5members.
- Take care to see that proper scoring is done by all the panel members.

### 17.4 Materials required:

1. Stainless steel knife
2. Plates
3. Forks

4. Glass tumblers
5. Towel
6. Water

1.

## 17.5 Procedure:

- Collect well ripe sample fruits and wash them.
- Except one or two fruits, peel and cut the fruits into suitable pieces with the help of a stainless steel knife and keep them in the plates.
- Arrange the plates with fruit pieces along with their fruits in a random order.
- Record their arrangement and remove their labels.
- Evaluate them organoleptically.

## 17.6 Observations:

The pupil should record the following observations in the table given on the next page.

contd.....

## TABLE
## SCORE CARD FOR EVALUATING THE TASTE OF FRUITS

| Sl. No. | Fruits and its cultivator | RATING POINTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | General appearance of the fruit | | | Texture | | | Taste | | | Flavour and aroma | | |
| | | 10 (Good) | 8 (Fair) | 5 (Poor) | 10 (Good) | 8 (Fair) | 5 (Poor) | 10 (Good) | 8 (Fair) | 5 (Poor) | 10 (Good) | 8 (Fair) | 5 (Poor) |

The pupil should evaluate the cultivars of at least two fruit crops. The rating of the cultivar is done based on total scoring by each.

17.7 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | GRADE |
|---|---|
| - know about the constitutes the taste; | |
| - know the different types of taste; | |
| - know the different types of flavours on odours; | |
| - group the varieties based on the taste of fruits; | |
| - evaluate the cultivars by taste. | |

The teacher should evaluate the pupil for the above abilities.

17.8 Questions:

1. What do you understand by 'Taste'?

2. What are the basic types of tastes?

3. What are the other factors which contribute to taste?

6. Why the knowledge of taste of cultivars of fruit crops is necessary?

7. State whether the following statements are TRUE or FALSE. Round off the correct answer.

   1) Colour of the fruit is the most important criterion in the organoleptic evaluation of fruit. T/F

   2) Refractometer reading gives the T.S.S. of fruits. T/F

   3) Quinine sulphate is used as a standard for measuring the sourness of a fruit. T/F

   4) Taste panel method is a subjective method. T/F

   5) 'Taste' and 'flavour' are synonyms. T/F

   6) Chemical methods of flavour assessment is more reliable than taste panel method. T/F

## 18. Activity Unit: CALCULATION OF COST OF CULVITATION IN DIFFERENT FRUIT CROPS.

### 18.1 Instructional Objectives:

The pupil should be able to:

- collect the information on cost of cultivation of important fruit crops of the locality;
- compute the cost of cultivation and returns for various fruit crops;
- visualise the amount of money spent for various inputs of production;
- recognise the importance of the knowledge of cost of cultivation for planning and for making decisions relating to fruit enterprises.

### 18.2 Relevant information

What is the need for computing the cost of cultivation?

The performance of any enterprise, such as fruit growing is reflected by the cost of production and the returns thereof, Reliable data on costs, physical inputs, efficiency factors and net returns would be extremely useful to the farmers for planning objectives and for making decisions relating to the enterprise under consideration. It is in this context that studies on the economic aspects of any enterprise assumes great importance. Such studies are also useful for commercial banks and other institutional financing agencies in estimating the credit requirements of an enterprise and in formulating their lending policies.

18.3 Precautions:

- Plan in advance to collect the information on various inputs and returns.
- Collect the information on every activity of cultivation of the crop.
- Use the current rates of inputs for calculating the cost of cultivation.
- Family labour utilised in the cultivation of fruits should also be included in the calculation of cost of cultivation.
- For calculation of returns, use the wholesale rates.

18.4 Materials required:

i. Table of current daily wages or labour charges in the locality,
ii. Current price list of fertilizers and pesticides.
iii. An idea of the current market prices.

18.5 Procedure:

- The necessary data to calculate the cost of cultivation of a fruit crop may be obtained in one of the following two ways:

  a) by actually growing the fruit crop and maintaining a full account of money spent on all activities/items of cultivation of the fruit crop, recording the yield and selling the fruits in the market.

b) Collecting the information on cost of cultivation and on returns from reliable progressive farmers or from institutions who would have maintained records and accounts for all the operations in the cultivation of the fruit crops.

After collecting the data, calculations should be made to compute the cost of cultivation and returns per hectare in the proforma given.

## 18.6 Observations:

The pupil should collect the information on cost of cultivation and the returns of fruit crops in the following format:

| Item: | Cost per ha. (in rupees) |
|---|---|
| I. Operational Costs | |
| 1. Labour | |
| - Land preparation, digging etc. | |
| - Fertiliser application | |
| - Irrigation | |
| - Pruning | |
| - Intercultivation | |
| - Plant protection | |
| - Watch and Ward | |
| - Harvesting | |
| - Handling, transportation and marketing | |

- Others.

2. Seeds/Planting material
3. Manures and fertilizers
4. Plant protection
5. Electricity charges(if any).
6. Repairs and maintenance
7. Other costs (if any)
8. Interest on working capital

Sub-total (I).

II. Fixed costs:

1. Land revenue.
2. Depreciation
3. Interest on establishment cost.
4. Interest on value of requipment.
5. Rental value of land.
6. Sub-total

Gand total (I + II)

III. Returns

1. Production(tonnes)
2. Gross income

IV. Net returns

Net returns = Total cost of cultivation (Total of I&II) - Gross income (III).

18.7 Calculations:

If data is collected for less or more than a hectare, calculations should be made to express for one hectare. The data for labour, if available in terms of number of men and women utilised, should be appropriately converted in terms of money spent by using the current wage rates.

18.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

| | GRADE |
|---|---|
| - plan for the collection of data on cost of cultivation of fruit crops;<br>- calculate actually the cost of cultivation of fruit crops and to work out net returns from them;<br>- realise the importance of the knowledge of cost of cultivation in selecting and growing suitable fruit crop for the locality. | |

The teacher should evaluate the pupil for the above abilities.

18.9 Questions:

i. Which is the major input in the cultivation of grapes, mango, pomegranate?

ii. What are the factors contributing to the fluctuations of cost of cultivation?

iii. Does the market price influence the selection of a particular fruit crop for cultivation? if so how?

iv. State whether the following statements are TRUE or FALSE. Round off the correct answer.

a) Family labour need not be included in estimating the cost of cultivation. T/F

b) In crops like mango and citrus, it is possible to control production in relation to ruling market prices. T/F

c) Fruit crops suffer more from fluctuating prices as compared to food crops. T/F

d) Cost of cultivation of a particular fruit crop does not change every year. T/F

e) In estimating the cost of irrigation, only the power for pumping water is taken into consideration and not the cost of water.

## 19. Activity Unit: STUDY OF MARKETING OF FRUITS

### 19.1 Instructional objectives:

The pupil should be able to:

- know the various steps involved in marketing of fruits;
- prepare the fruits for marketing after harvest;
- understand the consumers' needs and reactions while buying the fruits;
- acquaint himself with the need and methods of grading and packing.

### 19.2 Relevant information

What is marketing?

Marketing is buying and selling. It is process subjected to the economic laws of supply and demand. To seel or want to sell indicates a supply. To buy or want to buy indicates a demand. If the supply of an item is greater then the demand for that item, there will be downward trend in price. If the supply is short i.e., not great enough to meet the demand, the price trend is upward.

What is preparation of fruits for marketing?

After harvest, many steps are necessary for the preparation of fresh fruits for market. The number and type of treatments vary with the particular product. But with most fruits, the following steps are involved: cleaning, drying, shorting, sizing and packaging. With some fruits, additional treatments are typical. These may include removing field-heat, trimming, treating with disinfectant or fungicide, waxing and curing.

a) Cleaning:

Before fresh fruits are marketed, various amounts of cleaning are necessary. Cleaning essentially involves the removal of soil, dust, adhering debris, insects, and spray residues.

b) Drying:

Drying is often practised to minimise the growth of decay organisms. This may involve absorption of excess water by sponge-rubber, rollers, or in some cases, ~~a bl~~ast of warm air to evaporate moisture from the surface of the fruits. A simple open air-drying is also commonly followed whenever other facilities are not available.

c) Sorting:

After cleaning, shorting, which entails the removal of items unsuitable for packing, is required. In most cases, sorting is done by hand. Fruits damaged by insects, diseases, or mechanical injury, which are obviously unfit for sale, are separated from the produce. It is also a common practice for sorters to segregate the fruits into grades on the basis of colour or other visible characteristics, on which a grade is based.

d) Waxing:

Some fresh fruits are waxed as a part of the packing operation to minimise the moisture loss or to improve appearance. The wax is usually applied either by dipping or by spraying.

e) Packing:

Packing affords protection, convenience, economy and appeal. A variety of wooden containers(barrels, boxes, crates and baskets) are generally used. The materials used for packing differ with the product. The term pre-packaging has been used for the process of putting the produce in a consumer unit package at some point before it is put on display in the retail store.

Transportation

Transportation for marketing may be a short movement of the fruits handled by the growers themselves, or by the middle dealers, or transportation for long distances. In the first case, trucks, pick-up vans or bullock carts may be used, while the latter has to be by rail or shipping.

Storage and preservation:

The demand for most fruits is continuous. Their seasonal production and their rapid deterioration after harvest make preservation and storage essential in order to ensure an extended supply.

## Distribution

Marketing channels are those agencies that handle a commodity all the way from producer to consumer. In general, horticultural commodities travel from the producer to wholesaler, and next to retailer to consumer.

## What is the importance of quality maintenance in the marketing of fruits?

Many factors tend to modify the fruit quality. Good harvesting techniques and storage practices maintain or improve fruit quality. Careful handling to avoid bruising is important in quality maintenance. Not only do bruised produce appears less attractive and results in varying amounts of wastage, but also increases the loss by spoilage even in the display counters. Grading on the basis of size and quality gives the customer a choice of both quality and price. A single item of inferior grade maywbr the grade of the entire lot. Such individual items should be removed to improve the grade and general appearance.

## What to look for the marketing?

Whether buyer or seller, whether consumer or producer, factors to consider in evaluating the various items of produce are the same. The ultimate goal is the satisfaction of consumer. If the consumer is satisfied, he is more willing to pay higher price, the retailer is satisfied because he is making a profit and is sserving the community. The producer is happy because his best efforts have resulted in good products that give him a profit and satisfaction of helping in feeding the society.

Mature and well coloured fruits are desirable. Citrus fruits that are smooth and firm, yielding slightly to pressure, are sufficiently ripened. Discoloured and fruits with water soaked areas indicate partial breakdown. Apples and pears should be firm and crisp. Soft fruits indicate their storage and they should be used immediately. Grapes that are plump, firm, and in clusters are of good quality. When they become over ripe, the stem ends of individual grapes break down and grapes shutter from the cluster. Tropical fruits such as mango, banana, pineapple and papaya are harvested when they are green or yellowish green for shipment to distant markets. When ready for use, they should be firm but yielding to slight pressure of the hand or fingers.

## What is the importance of consumer appeal and satisfaction?

The fruit producer should make every effort to have the produce look appealing and show to the best advantages. Clean floors, clean tables, clean containers, clean fruits, and clean employees give consumer appeal and confidence in retail store.

## 18.3 Precautions:

- Availability of fruits, preferably from the pupils' plants should be ascertained.
- Materials/facilities necessary for harvesting, grading, packing and transportation should be ascertained.
- The modes to dispose off the produce should be thought of in advance and accordingly all the necessary prior arrangements for quick marketing of fruits should be made.
- Fruits should be harvested only at the right stage of maturity.
- All care should be taken to avoid mechanical injury at the time of harvest.
- Necessary precautions should be taken to save the fruits from spoilage/damage.
- Be conversant with the market news/trend in marketing

## 18.4 Materials required:

i. At least two fruit trees with matured fruits ready for harvest.

ii. Packing material such as card-board box, wooden box etc.

iii. Transportation facilities to transport the fruits from the orchard to the market/disposal point.

iv. Weighing scales.

v. Wax and waxing facilities.

vi. Facilities for cleaning, drying.

19.5 Procedure:

- Choose at least 2 fruit crops for the study.
- Harvest the fruits when they are ripe.
- Clean the fruits, if necessary, and dry as required.
- Short out and group the fruits into various grades based on their size or colour or any other character of market value.
- Wax the fruits, if necessary, depending on the type of fruit selected.
- Pack the graded fruits in appropriate packages.
- Label the packages with the variety name and grade (if established).
- Transport the packages to the local market or cooperative societies.
- Study the consumers' prefernce for various grades.
- Fix the demand price
- Sell the fruits.

19.6 a) The pupil should record the following observations in the given table:

| Name of the fruit | Cultiver | Quantity harvested | Quantity of fruits culled | Grades with quantity and description of each | | | | Packing material used if any(Wooden Boxes crates, baskets) | Value realised for the Unit amount of fruits gradewise | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $G_1$ | $G_2$ | $G_3$ | $G_4$ | | | |

b) The pupil should be able to observe and record the following:

- Important characters of the fruits influencing the consumer prefernece.
- Reaction of the buyers to the price and grado of the fruit.

19.7 Expected behavioural outcome:

The pupil acquires the following abilities to:

- plan marketing of fruits;
- realise the importance of grading for market appeal;
- know the steps involved in the marketing of fruits;

GRADE

contd....

- know the different agencies involved in marketing;
- distinguish between good and bad lot of fruits for market preference;
- evaluate the consumer's preferneee.

The teacher should evaluate the pupil for the above abilities.

## 19.8 Questions:

i. What are the steps involved in marketing?

ii. Is quality of fruit an important factor in marketing? If so, why?

iii. As a consumer, what do you look for, besides price in any given five fruits?

iv. What portion of the total cost of production of a fruit is shared by marketing cost?

v. What are the precautions one should exercise in handling the fruits?

vi. Fill in the blanks:

1) Waxing of the fruits extends its__________life.

2) A higher supply of fruits in the market leads to the reduction of ______________

3) Use of fungicides will protect the fruit from infection by _________________

4) Loss of water from the fruit can be brig brought down by __________ treatment.

vii. Match the following:

| A | B |
|---|---|
| a) Bruising of fruits | a) Reduction in price |
| b) Glut | b) Quick spoilage |
| c) Grading | c) Important factor controlling fruit quality |
| d) Colour | d) Ensures better price. |

## 20. Activity Unit:

### STUDY OF A DECLINING ORCHARD IN THE LOCALITY - THE CAUSES AND SUGGESTIONS FOR IMPROVEMENT.

### 20.1 Instructional objectives:

The pupil should be able to:

- understand the term decline - with reference to yield and plant growth;
- understand the reasons for decline;
- understand the common symptoms of decline in a given tree crop;
- suggest certain remedial measures for specific declining orchards.

### 20.2 Relevant information:

Why the trees decline?

In the perennial crops like citrus, various rootstocks used against specific problems (for vigour, salt tolerance, frost tolerance, disease tolerance). Incompatibility between stock and scion leads to decline conditions in many cases.

Citrus plants are often affected by a variety of diseases - fungal, bacterial and viral. Many insect pests are also associated with decline and they may also transmit diseases.

The needs of citrus plants for especially the minor elements is specific and deficiencies often occur. acute deficiencies, decline may set in.

Negligence of the plants for a few years leads to decline in the yield and plant growth. In certain seed propagated citrus like sour lime or even in mandarins, only a few plants contribute for yield. Higher percentage of genetically superior plants existing in an orchard contribute to the yield, or else the yields are bound to be low with low growth performances. On many occasions, the adverse soil conditions (high salinity/alkalinity/pH/bad drainage/high water table) and adverse environmental conditions like continued drought etc. also lead to decline of the trees.

Why the study should be conducted?

The study helps to find out the probable reasons for decline and guides the workers to correct the problems in the declining orchard.

## 20.3 Precautions:

- Survey the plant materials planted - their source of procurement, rotstock used, date of planting etc.
- Study the performance record maintained, if any, for the crop where detailed information about the date of planting, various cultural practices, yield records etc. could be available. Such information may help give clues to pin-point reasons for decline of the orchard.

## 20.4 Materials required:

i. Hand lens

ii. Paper covers

iii. Specimen jars

iv. Collection bags (for soil samples, leaf samples et

v. Performance record - yield, yearwise.

vi. Records - Calender of operations followed, incidence of diseases and pests recorded etc.

## 20.5 Procedure:

- Visit the orchard and examine the general health status of the trees.
- Record the disorders - insect/disease/soil problems/nutritional problems, etc.
- Examine the performance record - work out how many trees are performing poorly/satisfactorily/ well.
- Estimate the yield range and average yield of the trees.
- Draw the normal distribution curve based on the yield performance of individual trees.
- Examine the possible remedial measures to be suggested.

## 20.6 Observations:

- Examine the trees and arrive at remedial measures. Observe carefully the:

  a) Trees to be removed.

  b) Trees to be rejuvenated by top working.

  c) Trees to be protected against diseases/insects.

  d) Pests/diseases/soil problems existing in the orchard.

  e) Abstract of performance record.

     i) Prepare a model of performance record in the following table:

contd.......

Performance Record (Yield in kg.)

| Tree No. | Number of fruits | Yield in kg | Insect problems | Disease problem | Incompatibility | Deficiency | Soil condition |
|---|---|---|---|---|---|---|---|
| 1. | | | | | | | |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |

ii) Prepare frequency table:

Number of very well performing trees.

Number of trees performing satisfactorily.

Number of trees performing poorly.

Number of trees not yielding.

iii) Draw the frequency distribution curve.

iv) Draw the Pye Chart.

20.7 Calculations:

Work out percentage of productive trees, unproductive trees, disease affected trees, insect affected trees, incompatibility problems, range of yield etc.

20.8 Expected behavioural outcome:

The pupil acquires the following abilities to:

GRADE

- understand the general factors contributing towards orchard declining;
- understand the need for studying the problems in declining orchards;
- understand the remedial measures needed to rectify such problems;
- understand the mistakes committed in the orchard management practices;
- understand the need for maintaining the tree performance records;
- take appropriate decisions while planting new plantations and avoid such problems.

The teacher should evaluate the pupil for the above abilities.

20.9 Questions:

i. What is performance record?

ii. What is meant by orchard efficiency studies?

iii. Orchard efficiency studies are very important in seedling populations in an orchard, why?

iv. What factors contribute more towards declining of the orchards?

v. What do you mean by deficiency symptoms?

vi. What are the common nutritional deficiencies met with citrus? How are they corrected?

Appendix - I

## LIST OF IMPORTANT NURSERIES IN INDIA

### ANDHRA PRADESH

1. Agri-Horticultural Society of Hyderabad, Office of the Government Horticultureist, Hyderguda, Hyderabad.
2. Government Fruit Nursery, Kodur Post, Cuddapah Distt.
3. Government Fruit Farm, Rampachodaram, P.O. (Via.) Rajahmundri.
4. Agricultural College and Farm, Baptla, Guntur District.

### ASSAM

1. Fruit experimental Garden, K and J Hills, Shillong.
2. Citrus Fruit Research Garden, K and J Hills, Shillong.

### BIHAR

1. Government Horticultural Garden, P.O.Sabour, Bhagalpur.
2. Government Citrus Development Farm, P.O. Chaiki, Daltonganj.
3. Indian Seed and Farm Agency, Gulzarbagh, Patna.
4. D.V.O. Experiment Station, Sri Deochander P.O. Gouriakuna and Hazaribagh.

### DELHI

1. Sunder Nursery, Nizamuddin, New Delhi
2. Asoka Nursery, Mehrauli, New Delhi.
3. Rajoria Nursery, Roshnara Garden, Delhi.

## GUJARAT

1. Agricultural School Nursery, Baroda.
2. Government Gardens, Lalbagh, Junagadh.
3. Fruit Research Station, Gandevi, Dist. Surat.
4. Government Plantations, Mahuao P.O. District, Bhavnagar.

## HIMACHAL PRADESH

1. Mashobra Fruit Research Station, Dist. Mahasua.
2. Fruit Research Sub-Station, Chini, Mahasua District.
3. Fruit Research Station, Dhaulatuan, Dist. Sirmur.

## JAMMU AND KASHMIR

1. Flower Breeding Nursery, Lalmandi, Srinagar.
2. Union Seed Farm, Srinagar.
3. Central Seed Farm, Srinagar,
4. State Government Nursery, Srinagar, J&K.

## KARNATAKA

1. Horticulture Experimental Station, Chethalli, North Coorg.
2. Horticultural Development Officer, Gonicoppal, South Coorg.
3. Regional Research Station, Dharwqd.
4. District Horticultural Nursery, Chickmagalur.
5. Indian Institute of Horticultural Research Nursery, Hassarghatta, Bangalore-560080.
6. Indo-Americal Hydbrid Seeds, 42/1, Yediyur, Banashankari II Stage, Bangalore-560 070.

KERALA

1. Agri-Horticultural Society, Trivandrum.
2. Agricultural College Farm, Velleyain, Trivandrum.
3. Government Central Farm, Ollukara, Trichur.
4. Agricultural Research Station, Pattambi.

MADHYA PRADESH

1. Government Citrus Pedigru Nursery, Pachmarhi.
2. Government Gardens, Pachmarhi.
3. Vegetable Seed Farm, Silari.

MAHARASHTRA

1. Bombay Seed Supply & Co., Bombay-8.
2. Agri-Horticultural Society of Western India, Poona-1.
3. Palekar and Sons, Sitaram Buildings, Near Craford Market, Bombay.
4. Gandhi and Company, Rameshwar Chowk, Poona-2.
5. Government Gardens, Nagur.

ORISSA

1. Citrus Fruit Research Station, Angul, District : Dhenkanal.
2. Rajendra Experimental Farm, Bhalangir Dist.
3. Rajni Nursery, Malipura, P.O. Mahanga, Cuttack District.
4. Cuttack Nursery, Cuttack.

PUNJAB

1. Government Flower Nursery, Patiala.
2. Government Nursery, Pinjore.
3. Horticultural Research Station, Kulu.
4. Lyallpur Agri. Farm and Nursery, Jind.
5. Government Nursery, Karnal.

RAJASTHAN

1. Basant Bahar Agri. Farm and Nursery, Durgapur.
2. The Rajasthan Nursery, Jaipur.
3. Garden Nurseries, Udaipur.
4. Rajasthan Seed Store and Nursery, Udaipur.

TAMIL NADU

1. College Orchard, Agri. College and Research Institute, Coimbatore-3.
2. Agricultural Research Station, Nanjanad, Nilgiris.
3. J.G.Fortshi and Company, United Nilgiris Horticultural Nurseries, Coonoor, Nilgiris.
4. State Nursery, Sembanarkoil, Mayavaram Taluk, Tanjore Distt.
5. Fruit Research Station, Cape Comorin.
6. Government Botanic Gardens, Ootacamund, Nilgaris.

UTTAR PRADESH

1. Government Nursery, Vegetable Research Farm, Kalianpur, Kanpur.

2. District Nursery, Agricultural Farm, Bahraich.
3. National Nursery, Anithia, Salimpur, P.O. Katori. Lucknow.
4. Kisan Nursery, Proprietor Sattar Ahmad, Mahmood Nagar, Malihabad, Lucknow.
5. Jawahar Park Nursery, Aligarh.

WEST BENGAL

1. State Agricultural Farm, Kalimpong P.O. Darjeeling.
2. National Nursery, 46, Ramdhan Mittar Lane, Shyambazar, Calcutta-4.
3. State Agricultural Farm, Midanapore P.O. Midanapor, District.
4. Maunas Nursery, Lenlti, P.O. Howrah.
5. The Standard Nursery (Regd.) Kalimpong P.O. Darjeeling Dist.
6. Sutton & Sons, 13-D Russel Street, Calcutta.

Appendix II

## List of Contributors

1. DR. K.M. BHOJAPPA,
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# Questionnaire for Collecting Opinion of
# Teachers And Pupils
# On The
# INSTRUCTIONAL-CUM -PRACTICAL MANUAL

DEPARTMENT OF VOCATIONALIZATION OF EDUCATION
National Council of Educational Research and Training
Sri Aurobindo Marg, New Delhi - 110 016.

1984

Dear Teacher/Pupil,

We are happy to place this Instructional-cum-Practical Manual at your disposal with the hope that it will help you conduct some of the practical works prescribed in the syllabus or practices necessary to gain thorough vocational expertise.

The Manual does not conform to syllabus of any particular State but includes most of the important activities common in syllabi of different States. This is an experimental edition with ample scope for further improvement through feed-back from you. We solicite your active co-operation for the improvement of the Manual.

After having used the Manual for a year or more, kindly read the appended questionnaire carefully and write down the answers precisely and exactly to-the-point. Use additional sheet of paper if the space provided for is insufficient. Fold the questionnaire accurately and mail it to the following address :

Dr.A.K.Dhote
Programme Coordinator
Department of Vocationalization of Educati
National Council of Educational Research
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## QUESTIONNAIRE FOR THE TEACHERS

INSTRUCTIONAL-CUM-PRACTICAL MANUAL ON ______________________

A. Name of the Teacher
(in block letters) ______________________

B. Name & Postal Address
of the Institution ______________________

______________________

______________________

C. i. Qualification ______________________

ii. Teaching Experience ______________________

iii. Professional or Field Experience ______________________

______________________

1. Do the activities covered in the Manual develop vocational expertise in the students?

Yes/No

2. List the activities included in the Manual which do not figure in the syllabus

3. List the activities included in the Manual which do not figure in the syllabus, but are vocationally important

4. List the activities prescribed in the syllabus but not covered in the Manual.

5. List the vocationally important activities which are neither included in the Manual nor prescribed in the syllabus.

6. a) Does the relevant information given under every activit unit furnish enough theoretical background of the activity ?

Yes/No

b) If not, list the activity units where relevant information needs further modification.

| Activity Unit | Portion | Type of modification needed |
|---|---|---|

7. a) Does the relevant information contain any factual errors or inaccuracies ?

Yes/No

b) If yes, give the details

| Activity Unit | Error/Inaccuracy | Should read |
|---|---|---|

8. Did you notice any expressions/sentences in the manual which do not carry precise meaning or information ? If yes, then give the details :

| Page No. | Expression/Sentence | Would be more Appropriate |
|---|---|---|

9. Are instructional objectives pertaining to each activity unit rational ? If not list down the irrational, irrelevant or vague ones.

| Activity Unit | Irrational/irrelevant/Vague Objective |
|---|---|

10. Does accomplishment of the activity units result in realization of objectives in terms of behavioural outco in the pupil? If not point out the behavioural outcomes mentioned in the manul, which you feel are difficult to achieve through a particular activity unit ?

| Activity Unit | Behavioural outcome |
|---|---|

**11.** Is the procedure for activity units well sequential ? If not point out the discrepancies along with your own observations or suggestions .

| Activity Unit | Discrepancy | Observation/ Suggestions |
|---|---|---|

12. Did you notice any inaccuracies/discrepancies in the diagrames illustrating activity units ? If yes, point them out.

| Illustration No. | Discrepancy/Inaccuracy |
|---|---|

13. Your overall opinion about the Manual which may be useful in the effective improvement of the manual.

## QUESTIONNAIRE FOR THE PUPILS

INSTRUCTIONAL-CUM-PRACTICAL MANUAL ON ____________________

A. Name of the pupil
(in block letters) ____________________

B. Name and address of the school/college ____________________

____________________

C. Class ____________________

D. Medium of instruction ____________________

1. Enlist the portions of the Manual which you found difficult to understand and give reasons.

| Activity Unit | Proption of the Text | Difficulty experienced |
|---|---|---|
| | | |

2. Mention the places where you found the language to be difficult.

| Activity Unit | Page No. | Difficulty experienced |
|---|---|---|
| | | |

3. Point out the figures/illustrations which do not help in understanding the topic/theme.

| Illustration No. | Your observations/difficulty experienced |
|---|---|

4. Can you conduct the activity units yourself with the help of this manual ?

Yes/No

If not, point out the portions of activity units which need further elaboration or explanation.

| Activity Unit | Portions to be elaborated |
|---|---|

5. Was theoretical information given in the Manual useful to you in the examination ?

Yes/No

6. Do you know the scientific reason beh[illegible] that you take in the conduct of different [illegible]ents?

Yes/No

7. Your overall candid opinion about the Manual.